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THESIS

HOW THE NAVAL AVIATION MAINTENANCE PROGRAM (NAMP) AT THE INTERMEDIATE LEVEL CAN BECOME ISO 9000 QUALITY MANAGEMENT SYSTEM COMPLIANT

Stephen Kurt Brenneman

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Thesis Advisors: Donald Eaton
Kenneth Euske

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6. AUTHOR(S)
Brenneman, Stephen K.

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13. ABSTRACT ***(maximum 200 words)***

This thesis examines the similarities and differences between the Naval Aviation Maintenance Program (NAMP) and International Standards Organization (ISO) 9000 quality management systems (QMS), and what changes must be done to bring the NAMP to ISO 9000 standards. The NAMP is naval aviation's overall guiding document that outlines command, administrative, and management relationships, and assigns maintenance policy and procedure responsibilities to the respective individuals for management. ISO 9000 is a series of international standards establishing requirements and guidelines for maintaining an organization's quality system, which focuses on prevention rather than detection This thesis will first examine ISO 9000 QMS aspects in relation to intermediate maintenance actions. Next, a plan for implementing the ISO 9000 QMS in naval aviation's organizational and intermediate maintenance activities is developed. Specifically, process maps are described for QM documentation, policies, and procedures under both the NAMP and ISO 9000, and then compared and contrasted. Then, a sample ISO 9000 quality manual for the Tool Control Program (TCP) on an intermediate maintenance activity, including how this manual can satisfy the 20 tenets of the ISO 9000 QMS is developed. Finally, recommended changes to NAMP QM procedures, processes, and policies are provided along with expected benefits naval aviation will receive if ISO 9000 is implemented.

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HOW THE NAVAL AVIATION MAINTENANCE PROGRAM (NAMP) AT THE INTERMEDIATE LEVEL CAN BECOME ISO 9000 QUALITY MANAGEMENT SYSTEM COMPLIANT

Stephen K. Brenneman
Lieutenant (Junior Grade), United States Navy
B.S., Indiana University, 1993

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ABSTRACT

This thesis examines the similarities and differences between the Naval Aviation Maintenance Program (NAMP) and International Standards Organization (ISO) 9000 quality management systems (QMS), and what changes must be done to bring the NAMP to ISO 9000 standards. The NAMP is naval aviation's overall guiding document that outlines command, administrative, and management relationships, and assigns maintenance policy and procedure responsibilities to the respective individuals for management. ISO 9000 is a series of international standards establishing requirements and guidelines for maintaining an organization's quality system, which focuses on prevention rather than detection. This thesis will first examine ISO 9000 QMS aspects in relation to organizational and intermediate maintenance actions. Next, a plan for implementing the ISO 9000 QMS in naval aviation's organizational and intermediate maintenance activities is developed. Specifically, process maps are described for QM documentation, policies, and procedures under both the NAMP and ISO 9000, and then compared and contrasted. Then, a sample ISO 9000 quality manual for the Tool Control Program (TCP) on an intermediate maintenance activity, including how this manual can satisfy the 20 tenets of the ISO 9000 QMS is developed. Finally, recommended changes to NAMP QM procedures, processes, and policies are provided along with expected benefits naval aviation will receive if ISO 9000 is implemented.

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ACKNOWLEDGMENT

To my loving wife Jill, who stood by me through the whole thesis process.

I. INTRODUCTION

A. PURPOSE

The purpose of this thesis is to discuss what differences exist between the Naval Aviation Maintenance Program (NAMP) and the International Standards Organization (ISO) 9000 quality management system (QMS), and what changes must be done to bring the NAMP to ISO 9000 standards. LT Couch and LT Decker [1] addressed needed changes at the organizational level of naval aviation, this research goes one step further in adding intermediate level activities and providing solutions to bring the NAMP to ISO 9000 standards.

B. AREA OF RESEARCH

The area of research will consist of three topics. First, ISO 9000 QMS aspects in relation to organizational and intermediate maintenance activities are studied. Specifically, why changes to the NAMP's current quality system are necessary for the future prosperity of naval aviation. Second, a plan for implementing the ISO 9000 QMS in naval aviation's organizational and intermediate maintenance activities is developed. This plan focuses on what activities and intermediate steps that should take place for successful implementation of ISO 9000. Last, a sample ISO 9000 quality manual for the Tool Control Program (TCP) of an intermediate level maintenance activity, including how this quality manual can satisfy the 20 tenets of the ISO 9000 QMS is developed from

an existing NADEP Cherry Point quality manual. A case study is provided on a sample quality manual for the TCP.

C. BACKGROUND

The NAMP is naval aviation's overall guiding document that outlines command, administrative, and management relationships, and assigns maintenance policy and procedure responsibilities to the respective individuals for management [2]. ISO 9000 is a series of international standards establishing requirements and guidelines for maintaining an organization's quality system [3]. The NAMP quality management guidelines rely heavily on quality control (QC) and less on quality assurance (QA) to manage quality [1]. The ISO 9000 QMS, however, incorporates QA into existing QC production processes. This results in more efficiently run programs than traditional programs [3], like those established under the NAMP, which rely on oversight for quality management. For approximately 40 years, naval aviation organizational maintenance activities have managed quality using NAMP guidelines. While the quality system established under the NAMP guidelines has been effective in reducing the number of quality-control-related incidences, the annual number of these incidences is still unacceptably high [1]. The potential may exist, however, to improve the NAMP's quality system and to still further reduce the number of quality-control-related incidences in naval aviation maintenance.

The objective of this thesis is to determine what types of changes must be implemented into the NAMP at the organizational and intermediate levels to make it ISO 9000 compliant. Research done by Couch and Decker [1] examined the similarities and

differences between the NAMP and ISO 9000 QMS at the organizational level of aviation maintenance. A logical next step in this area of research is to examine the similarities and differences at the intermediate maintenance level, and then to develop a sample quality manual for both the organizational and intermediate levels of maintenance.

D. RESEARCH QUESTIONS

Primary

1. Why does the Navy need an ISO 9000 compliant system in naval aviation maintenance?

Secondary

1. What types of changes to the NAMP, concerning aviation organizational and intermediate maintenance, must be made to make it consistent with an ISO 9000 compliant QMS?

2. What are the differences in characteristics between the process maps of naval organizational and intermediate maintenance activities and process maps of ISO 9000 activities, and will the ISO 9000 QMS improve the organizational and intermediate level maintenance process?

3. What activities and intermediate steps should take place so that ISO 9000 could be implemented in organizational and intermediate maintenance activities?

4. What gaps currently exist between the ISO 9000 QMS standard and the NAMP's Tool Control Program, and what must be done to meet the requirements of the standard (GAP/Delta Assessment)?

5. What would a sample ISO 9000 quality manual for the Tool Control Program need to contain so that it satisfies the 20 clauses in the ISO 9000 QMS?

6. What would an intermediate aviation maintenance level ISO-compliant manual contain/look like?

E. SCOPE OF THE THESIS

This thesis studies what differences exist and what types of changes must be implemented between the NAMP and the ISO 9000 QMS in relation to organizational and intermediate aviation maintenance functions onboard a carrier. A case study is conducted on developing a sample ISO 9000 quality manual for the organizational and intermediate levels of maintenance. Due to the breadth of area in naval aviation maintenance, the quality manual will focus on one process, the Tool Control Program.

F. METHODOLOGY

The methodology used in this thesis research consists of the following steps:

1. Conduct a literature review of ISO 9000 QMS documents and the NAMP.
2. Analysis of studies conducted on the pros and cons of ISO 9000 adoption.
3. Examine Theses conducted on ISO 9000 QMS.
4. Conduct interviews with personnel at ISO 9000 naval facilities.
5. Conduct interviews with maintenance personnel and professors.

G. THESIS ORGANIZATION

The introduction in Chapter I identifies the purpose and area of research of the thesis, and states the primary and secondary research questions. Chapter II studies whether the proposed implementation of ISO 9000 into naval aviation will improve the quality system, and what factors must be present for successful implementation. Chapter III explains the twenty tenets of the ISO 9000 standard, determines the differences that exist between the ISO 9000 standard and the NAMP's Tool Control Program, and what the NAMP needs to do to meet these requirements. Lastly, Chapter IV provides conclusions, recommendations, and suggested areas of further research on the implementation of ISO 9000 into naval organizational and intermediate level maintenance.

H. BENEFIT OF THE STUDY

This research will give naval aviation a better understanding of what specific changes must be implemented to the NAMP to become ISO 9000 QMS compliant. Additionally, this study will help identify whether naval aviation should continue to pursue ISO 9000 certification, and if so, what steps and activities must be done for successful implementation.

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II. IMPLEMENTATION OF THE ISO 9000 QMS INTO NAVAL AVIATION ORGANIZATIONAL AND INTERMEDIATE LEVEL MAINTENANCE

A. INTRODUCTION

This chapter studies whether the proposed implementation of ISO 9000 into naval aviation will improve NAMP's quality system. This chapter includes a process map of how maintenance actions are currently performed in naval aviation organizational and intermediate level maintenance and a process map of the ISO 9000 process. Additionally, this chapter analyzes how the International Standards Organization 9000 quality management system will improve the Naval Aviation Maintenance Program (NAMP) at the organizational and intermediate maintenance level. Finally, this chapter looks at what activities and intermediate steps must take place for successful implementation of ISO 9000 into the NAMP.

B. IMPLEMENTATION OF ISO 9000 INTO NAVAL AVIATION

Since its implementation in 1959, the Naval Aviation Maintenance Program (NAMP) has drastically improved safety levels within naval aviation. Figure 1 shows the Class A mishap rate of aircraft from FY1950 until 31 August 1999. According to the Naval Safety Center, Class A mishaps are caused by maintenance malpractice at least 20 percent of the time [4]. The mishap rate, which is based on every 100,000 flight hours flown, has decreased significantly from 1950 until around 1990, when it stabilized. The initial decrease in safety levels can be directly attributed to the implementation of the

NAMP, the forming of the Aviation Safety Center, and angled decks on carriers. Since then, naval aviation has implemented more programs, but has not seen the same level of improvement as in the past. From FY 50 until FY 90 the mishap rate decreased from 54.6 to 2.78. The average mishap rate only decreased from 2.66 during FY 90-94 to 1.97 during FY 95-99. [5]

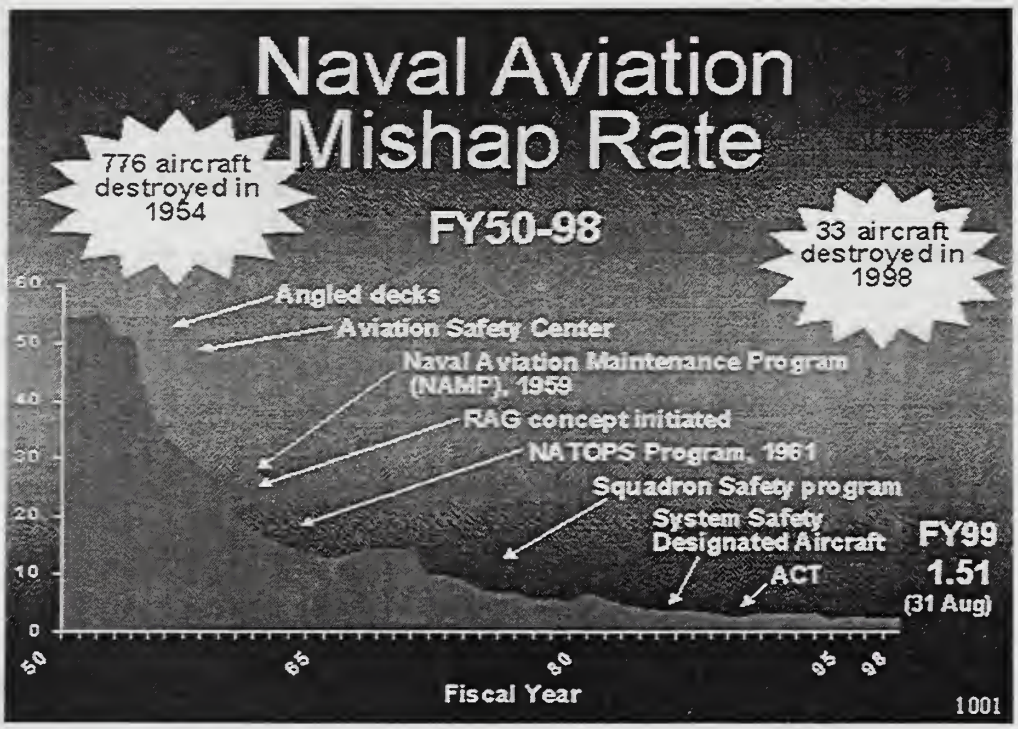

Figure 1. Naval Aviation Mishap Rate. From Ref. [5].

Other statistics have pointed to the fact that the NAMP's policies and procedures on naval aviation maintenance have reached a plateau. Table 1 lists the occurrences of Things Falling Off Aircraft (TFOA), a statistic that can be linked to maintenance malpractice. The data suggest that TFOA levels have been relatively stable over the past five years.

Year	Total Flying Hours	TFOAs
CY 94	1,637,988	1529
CY 95	1,670,015	1357
CY 96	1,626,448	1797
CY 97	1,519,549	1666
CY 98	1,500,150	1517
Total	**7,954,150**	**7866**

Table 1. Annual Reported Things Falling Off Aircraft Totals. From Ref. [6].

Retention rates of aviation-rated sailors can also be linked to the fact that naval aviation maintenance has not improved its processes, and that there appears to be opportunities for increased efficiency within aviation maintenance. Figures taken from the Naval Bureau of Personnel [7] show that retention of sailors involved in aviation maintenance have steadily decreased over the 1990's. Sailors state that longer working hours is one of the driving factors for separation [7]. Currently, sailors work longer hours, but the Class A mishap rates and TFOA rates still have not improved. Sailors can easily become disgruntled when the work they do adds no value or needs to be re-done. For example, a squadron or AIMD may spend weekends grooming, or "catching up", for an upcoming inspection. These working weekends would possibly not be necessary if proper procedures were in place to ensure quality work and upkeep was performed correctly the first time. The present decade's retention figures for Aviation Maintenance Administratrators (AZ), Aviation Technicians (AT), and Aviation Electronicmen (AE) are listed in Appendix A [7].

The Class A mishap rate and TFOA statistics shown above demonstrate that naval aviation maintenance has reached a plateau in quality levels. Also, the decreasing

retention rates of aviation-rated sailors can be linked to longer working hours, which may be required to maintain the current plateau of quality levels. Naval aviation may have captured essentially all of the continuous improvement that the NAMP has to offer. If this is true then quality management in aviation maintenance must be significantly changed to bring further improvements.

A recent 1998 survey by the Automotive Industry Action Group (AIAG) has shown that Quality System Requirement (QS-9000) compliant companies have seen real benefits since implementation. QS-9000 is the same as ISO-9000, but it is tailored for the automobile industry. A total of 208 companies involved in every process of automotive manufacturing and maintenance were asked to estimate the initial and ongoing net benefits from QS-9000. The responses are listed in Tables 2 and 3 below.

Sales	Benefits	Costs	Net Benefit
$500-999 mil	$ 22,500,000.00	$ 395,000.00	$ 22,105,000.00
$200-499 mil	$ 31,500,000.00	$ 205,681.00	$ 31,294,319.00
$125-199 mil	$ 325,000.00	$ 121,222.00	$ 203,778.00
$75-124 mil	$ 7,600,000.00	$ 257,520.00	$ 7,342,480.00
$25-74 mil	$ 4,000,000.00	$ 450,225.00	$ 3,549,775.00
$10-24 mil	$ 510,000.00	$ 11,600.00	$ 498,400.00
< $10 mil	$ 300,000.00	$ 78,000.00	$ 222,000.00

Table 2. Initial Costs and Benefits of QS-9000. From Ref. [8].

Sales	Benefits	Costs	Net Benefit
$500-999 mil	$ 30,000,000.00	$ 76,250.00	$ 29,923,750.00
$200-499 mil	$ 17,500,000.00	$ 59,385.00	$ 17,440,615.00
$125-199 mil	$ 9,000,000.00	$ 42,250.00	$ 8,957,750.00
$75-124 mil	$ 4,000,000.00	$ 67,000.00	$ 3,933,000.00
$25-74 mil	$ 4,000,000.00	$ 36,400.00	$ 3,963,600.00
$10-24 mil	$ 680,000.00	$ 35,100.00	$ 644,900.00
< $10 mil	$ 700,000.00	$ 25,900.00	$ 674,100.00

Table 3. Ongoing Costs and Benefits of QS-9000. From Ref. [8].

Two-thirds of initial costs were internal (e.g., internal audits, documentation, and salaries of personnel in training) and one-third for external costs (e.g., consulting, training, and registrar costs). Ongoing compliance costs were about one-fourth external and three-fourths internal. Benefits for the companies were related to improved defect rates, better on-time shipping performance, increased market share, and less rework. [8] The tables above show that organizations in the public sector find the ISO 9000 QMS method a worthwhile investment.

ISO 9000 has the potential to improve naval aviation in many ways. The next three sections of this chapter discuss the current process of intermediate level maintenance, the ISO 9000 process, and how and why the ISO 9000 process can improve naval aviation at the intermediate maintenance level.

C. PROCESS MAP OF NAVAL AVIATION ORGANIZATIONAL LEVEL MAINTENANCE

Figure 2 depicts the organizational level maintenance process for naval aviation. The process provided below describes a maintenance action that a typical squadron would experience. Discrepancies are submitted by Aircrew, maintenance technicians, or QA personnel within the squadron. These discrepancies are submitted by electronic form on the Naval Aviation Logistics Command Information System, or NALCOMIS. NALCOMIS is an automated Management Information System (MIS) that provides aviation maintenance and material management with timely, accurate, and

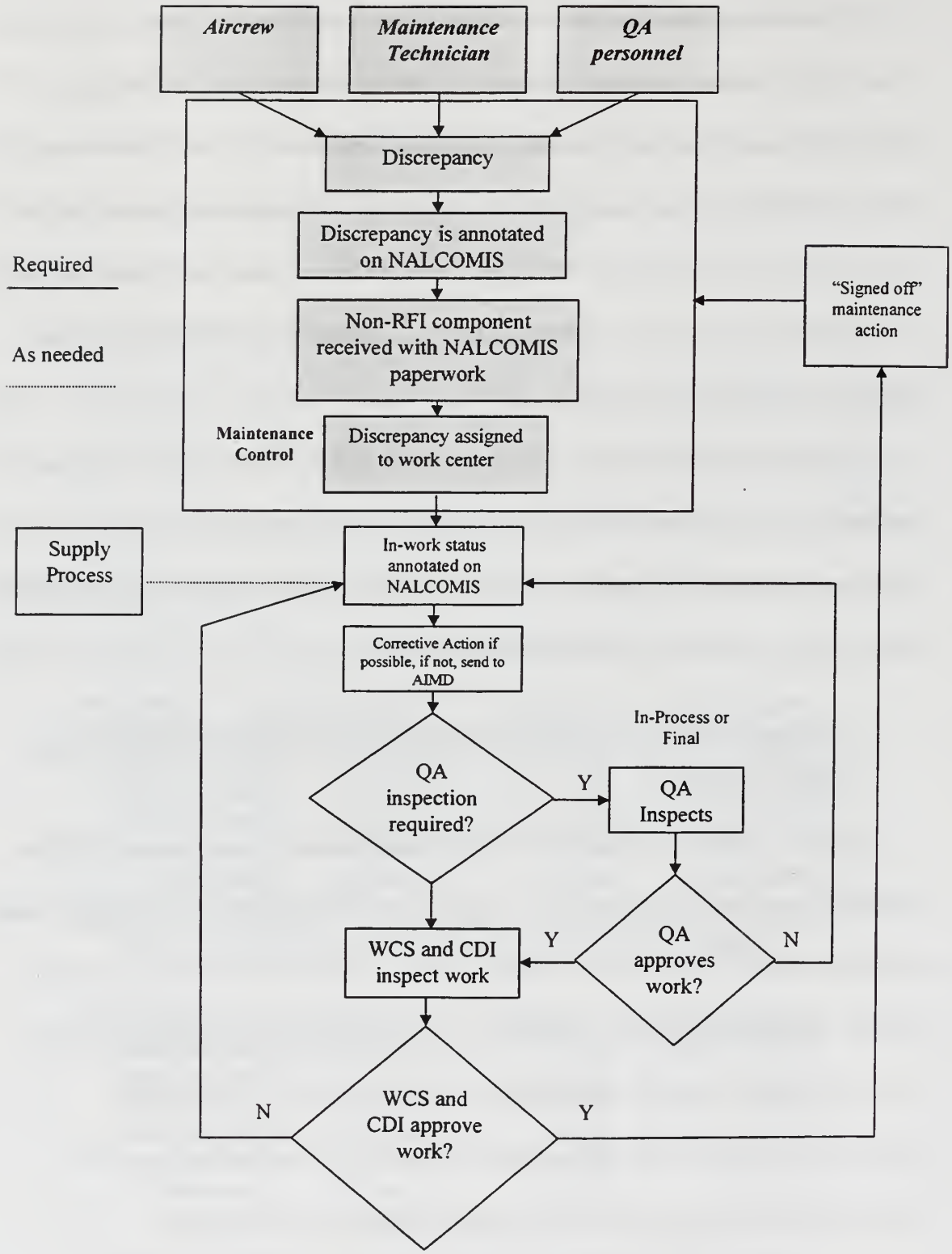

Figure 2. Process Map of Organizational Level Maintenance. From Ref. [2].

complete information on which to base decisions [9]. A non-ready-for-issue (non-RFI) component is usually the discrepancy in question. This component is sent to Maintenance Control, along with paperwork downloaded from NALCOMIS. This paperwork travels throughout the process with the non-RFI component, and is used for identification and accountability. [2]

As stated, discrepancies are submitted to Maintenance Control and the Maintenance Material Control Officer (MMCO). The MMCO is the central authority that coordinates all maintenance actions within the squadron. The MMCO is responsible for coordinating, monitoring, and prioritizing the entire sqadron's maintenance workload [1]. When Maitnenance Control wants a certain maintenance action completed, it assigns the discrepancy to the work center responsible for the maintenance required.

After the maintenance action is assigned to a work center, the work center goes into an "in-work" status, which is annotated in NALCOMIS. Maintenance personnel then work on the discrepancy and perform the corrective action required. If the corrective action cannot be performed, the component is sent to an intermediate maintenance activity for repair. Some non-RFI components require additional parts to fix the discrepancy. These parts are ordered through the Supply Department and the component is placed in an awaiting parts status until the desired part is received [2]. The supply process will not be explained further as it is beyond the scope of this thesis.

Certain maintenance actions, such as safety of flight discrepancies, require a QA inspection before it can be signed off. These inspections require a Quality Assurance

Representative (QAR) and can either be in-process or final inspections. In-process inspections are required when satisfactory task performance cannot be determined after completion of the task [1]. These inspections include functional testing, servicing, and installation. Final inspections are performed after the completion of a task.

Additionally, once the corrective action is complete, the Work Center Supervisor (WCS) and a Collateral Duty Inspector (CDI) must inspect the work. Work Center Supervisors are responsible for the overall quality of work performed by their work center, so they will want to ensure the work center is producing a quality product. CDIs are required to inspect all maintenance actions performed by their respective work centers. CDIs are assigned to the respective work center, but are responsible to the QA Officer (QAO) when performing such actions [2]. Upon successful inspection, the maintenance action is signed off and sent via NALCOMIS back to Maintenace Control for approval. Upon approval, the now RFI component is used for mission essential activities.

D. PROCESS MAP OF NAVAL AVIATION INTERMEDIATE LEVEL MAINTENANCE

Figure 3 depicts the intermediate level maintenance process for naval aviation. The process provided below describes a maintenance action that a typical AIMD would experience, and is very similar to the process an organizational level activity would encounter. Discrepancies are submitted by the Supply Department, an O-level squadron, or maintenance personnel within the AIMD. These discrepancies are also submitted on

NALCOMIS. The non-RFI component is sent to Production Control, along with paperwork downloaded from NALCOMIS.

Unlike an organizational maintenance activity, discrepancies are submitted to Production Control and the Production Control Officer (PCO). The PCO is the equivalent to the MMCO of an O-level squadron. Just like Maintenance Control, when Production Control wants a certain maintenance action completed, it assigns the discrepancy to the division and work center responsible for the maintenance required.

Upon the corrective action, the AIMD determines if a QA inspection is required using the same criteria as organizational maintenance activity. Additionally, once the corrective action is complete, the Work Center Supervisor (WCS) and a Collateral Duty Inspector (CDI) also must inspect the work.

Upon successful inspection, the maintenance action is signed off and sent via NALCOMIS back to Production Control for approval. Upon approval, the now RFI component is sent back to the activity or personnel requesting the work.

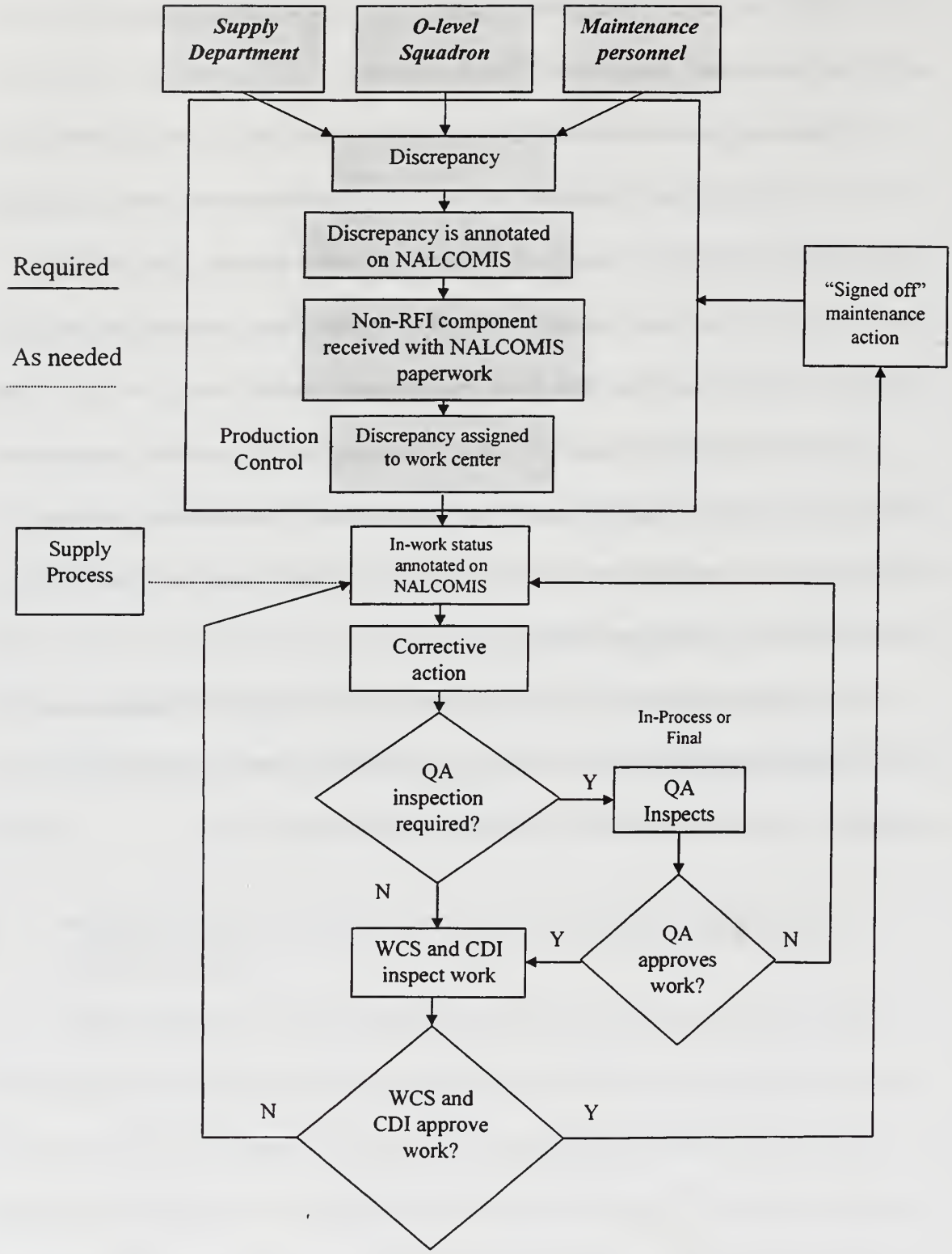

Figure 3. Process Map of Intermediate Level Maintenance. From Ref. [2].

E. PROCESS MAP OF THE ISO 9000 QMS

ISO 9000 requires an organization to document its quality system in such a way that management and employees can understand, accept, and use it. Without such a structure, the organization risks functioning as a collection of individuals rather than a team. Well-maintained documentation keeps everyone informed and ensures that all are working toward the same goal [10].

The ISO 9000 QMS is tailored to enhance any type of quality system within any organization. ISO 9000 focuses on prevention rather than detection. It builds on the existing quality system by instilling a philosophy of continuous process improvement. Because of this philosophy, the ISO 9000 operating process map is a simple input-process-output model as shown in Figure 3. As stated earlier, this model allows ISO 9000 to adapt to any organization's current quality system, building and improving the process.

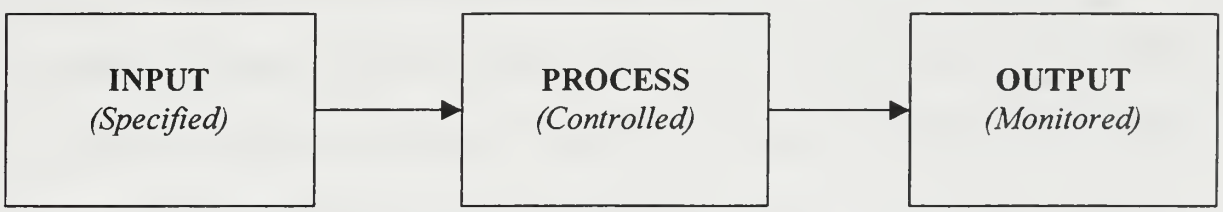

Figure 4. ISO 9000 Operating Process. From Ref. [9].

Implementation of a quality system to meet ISO 9000 standards seeks to ensure that the input is specified to a specific standard, that the process is controlled, and that the output is monitored for conformity to requirements [11]. The ISO 9000 QMS is discussed in more detail below, and how it can improve the NAMP's current quality system.

F. HOW ISO 9000 CAN IMPROVE NAVAL AVIATION ORGANIZATIONAL AND INTERMEDIATE LEVEL MAINTENANCE

The NAMP states that naval aviation is "Big Business." Naval aircraft fly over 1.7 million flight hours annually. To support this, intermediate maintenance activities process over 1.5 million repairables a year. Because of the enormity of these numbers, relatively small improvements in the quality system process can pay off big dividends in reducing costs of naval aviation, which have averaged $776.3 million a year between FY 92-96 on Class A mishaps alone [5]. The NAMP has a philosophy of performance improvement throughout all levels of naval aviation maintenance. Performance improvement is the NAMP's version of continuous process improvement. The NAMP states that as new techniques and concepts evolve, they must be evaluated to determine if they are sound. [2]

The NAMP however does not go into detail on how to attain performance improvement or how to evaluate new concepts. One can argue that this omission in the NAMP is a factor behind naval aviation's inability of improving the quality system. As stated earlier, current trends of Class A mishap rates, TFOA rates, and retention of aviation-rated sailors give us proof that the NAMP's "performance improvement" philosophy is not working. ISO 9000 has the capability to improve the NAMP in many ways.

First, ISO 9000 will require organizational and intermediate maintenance activities to perform continuous review of critical process points, corrective actions, and outcomes. The quality assurance process of ISO 9000 is shown in Figure 4. The process

starts with internal audits. Audits are performed to ensure that all the tenets of the standard are met by the organization. The ISO 9000 tenets are discussed in greater detail in Chapter III. Internal audits are not new to naval aviation. Naval aviation has an internal audit program called the Computerized Self-Evaluation Checklist (CSEC) [2]. The CSEC ensures the NAMP's standard operating procedures are under compliance.

After internal audits comes management review. Under management review, ISO 9000 procedures direct managers to look at deficiencies in the process and determine why it is not in compliance. This technique is similar to Toyota's "five whys", a process that forces management to ask the question "why" as many times as needed to get to the root cause of a deficiency. This is the first key difference between the NAMP's quality system and the ISO 9000 QMS.

Under the NAMP, deficiencies found after the CSEC audit are forwarded up the chain of command for review. This review may consist of a written notation by the Officer and Chief in charge. The NAMP, however, does not require Officers and Chiefs to find the root cause of a deficiency. It only requires the MO to "review/analyze CSEC reports and provide appropriate direction to Division Officers." [2] This lack of direction can lead to responses like "Let's fix this problem" or "We can do better than this" by Officers and Chiefs on the audit report, which does not require sailors to find the actual cause of the deficiency.

After management review the corrective action takes place. Under the ISO 9000 QMS, personnel are directed to find the root cause. If the root cause is located then the

corrective action has a greater chance of being successful. The QA process then starts over with internal audits to determine if the corrective action has worked.

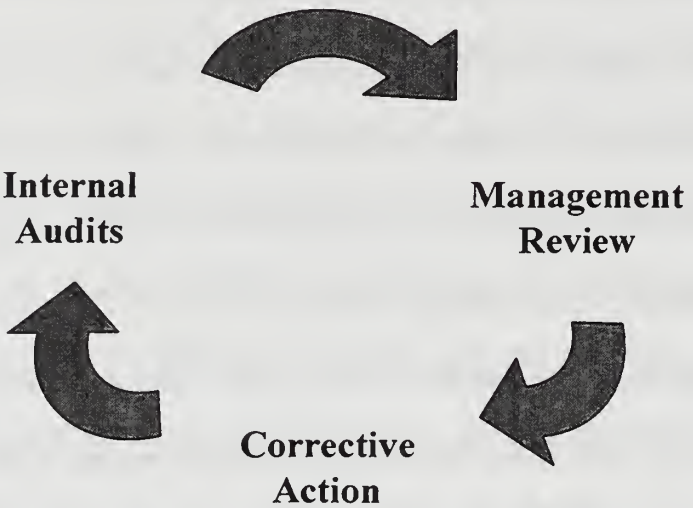

Figure 5. ISO 9000 QA Process. From Ref. [11].

Under the NAMP, the problem may be temporarily fixed, but might occur again because no one was explicitly directed to find the root cause. An example of this can be seen in the latest Navy Safety Center audit on naval aviation. Near the top of the third quarter FY 99 Aviation Safety Survey was the inability of squadrons and AIMDs to enforce accountability of Personal Protective Equipment (PPE) at the beginning and end of the work shift. The audit recommended that "all commands review the NAMP" to correct the deficiency [12]. The recommendation gives no in-depth guidance or even attempts to find the root cause of the problem.

ISO 9000 will give Officers, Chiefs, Petty Officers, and Airmen a greater opportunity to fix processes than the NAMP's current quality system by allowing them to

have a sense of ownership. This sense of ownership is fostered by the fact that ISO 9000 facilitates personnel involved in the process or procedure to fix the deficiency (the "five whys" technique). Sailors will be directed not to assume processes are the best they can be just because "that is the way we have always done it." This total quality awareness by all employees can promote a stronger employee "buy-in". As a result, retention levels may increase because sailors now know they own a process and are important to the overall maintenance effort.

On the other hand, the NAMP provides less flexibility for improving programs and procedures than ISO 9000. Under the current system, sailors may feel that they do not own the process and have little say in improving it. One way that sailors are given the opportunity to improve a process is through the Military Cash Awards Program (MILCAP). However, sailors that do submit suggestions on improving processes through the MILCAP can wait months for a response. This is because the MILCAP program has few time constraints on answering suggestions. [13] This seemingly lack of desire by upper management within naval aviation to improve a process may discourage sailors from submitting future suggestions.

A strength of the NAMP is that it incorporates Quality Control (QC) at each level of maintenance- organizational, intermediate, and depot. Looking back at Figured 2 and 3, the organizational and intermediate maintenance process maps show quality control checks by the Work Center Supervisor, Collateral Duty Inspector, and possibly the Quality Assurance Representative. These quality control inspections are also required in

organizational and depot level maintenance actions, and are performed by personnel who did not originally do the work [2]. This requirement of a second set of eyes looking at a maintenance action may increase the likelihood of a deficiency being identified. ISO 9000 can build on the NAMP's philosophy of QC and oversight by incorporating Quality Assurance (QA) and insight within maintenance actions [12]. With QC processes already implemented by the NAMP and additional QA practices made available by ISO 9000, naval aviation may become more efficient at all levels of maintenance. One of the goals within naval aviation maintenance is to ensure safe flights for crewmembers, and to minimize the likelihood of a lost life. Quality Control along with Quality Assurance management systems within naval aviation maintenance may minimize this likelihood of a lost life.

Another way ISO 9000 may improve naval aviation is through document control, which is much more thorough and stringent under ISO 9000. The NAMP does not give specific guidelines on the handling and storage of certain documents and records. Under ISO 9000, standardized procedures must be in place for all types of documents and records within a process or procedure [14]. Examples of document control with the Tool Control Program are discussed further in Chapter III.

The NAMP also does not provide process flows. It provides only the basics for establishing standard organizations, procedures, and responsibilities for the accomplishment of maintenance. One of the requirements for the ISO 9000 QMS is the documentation of process flows. This requirement helps an organization see a process

and determine if a step within the process adds value. Control of process flows, and how ISO 9000 can benefit intermediate level maintenance in this area, is discussed in greater detail in Chapter III.

ISO 9000 forces managers to plan for future operational commitments by requiring the elimination of wasted or excess resources on-hand. The NAMP has no guidelines for excess resources on-hand. From my experience and discussions with other Officers and Chiefs in naval aviation, work centers within aviation maintenance have a tendency to keep "thirty-year bins", which are storage bins for excess materials rarely used. These materials take up space, thus increasing storage costs of the organization.

Also, some materials that are stored in work centers, such as rubber gloves, have a shelf life. Use of these materials after expiration may result in a nonconforming product. Further discussion of this ISO 9000 requirement is in Chapter III.

ISO 9000 registration requires an external auditor, unlike the CSEC audits performed under the NAMP. Personnel within the maintenance activity perform CSEC audits. This can cause biased audits. For instance, a Quality Assurance Representative (QAR) may find it difficult to fail a work center on an audit if the entire maintenance activity will have to work that weekend as a result. A third party auditor is less likely to have such a bias.

Lastly, ISO 9000 is seen as a symbol of commitment. The ISO 9000 series requirements are generally accepted as good business practices [12], and organizations throughout the world are implementing it [15]. ISO 9000 registration at all organizational

levels within naval aviation maintenance will communicate to government contractors that naval aviation is serious about quality. ISO 9000 registration can also attract better contractors and weed out organizations that do not have a good quality system. There are two reasons for this. First, organizations know that ISO 9000 will require naval aviation to use the most efficient processes available, thus driving down costs. Reductions in waste and better handling and storage procedures of inventory are just a couple of examples of how ISO 9000 reduces costs. Some of these cost savings can ultimately be passed on to contractors, thus earning them a higher profit margin. Secondly, ISO 9000 will require naval aviation to demand quality from contractors. Under ISO 9000, deficiencies caused by the contractor will be identified more easily. This will likely influence companies with poor quality to avoid doing business with the Navy.

The ISO 9000 symbol of commitment can also help services with joint military endeavors. The United States Air Force (USAF) is currently considering ISO 9000 implementation. Once implemented, along with implementation in naval aviation, joint programs between the two services will be with greater trust and certainty of the other's quality system. Programs such as the Joint Strike Fighter (JSF) will enable both services to share common parts of the aircraft with each other, thus reducing overall inventory levels and cost.

G. REQUIREMENTS FOR SUCCESSFUL IMPLEMENTATION OF ISO 9000

For successful implementation of ISO 9000 into naval aviation intermediate level maintenance, the maintenance activity must have management involvement, training, and willingness for cultural change. All three of these activities are important and form the cornerstones for successful ISO 9000 implementation, as shown in Figure 5. Each activity is not a separate requirement, but overlaps with one another. For example, management involvement requires training, and training requires a willingness for cultural change.

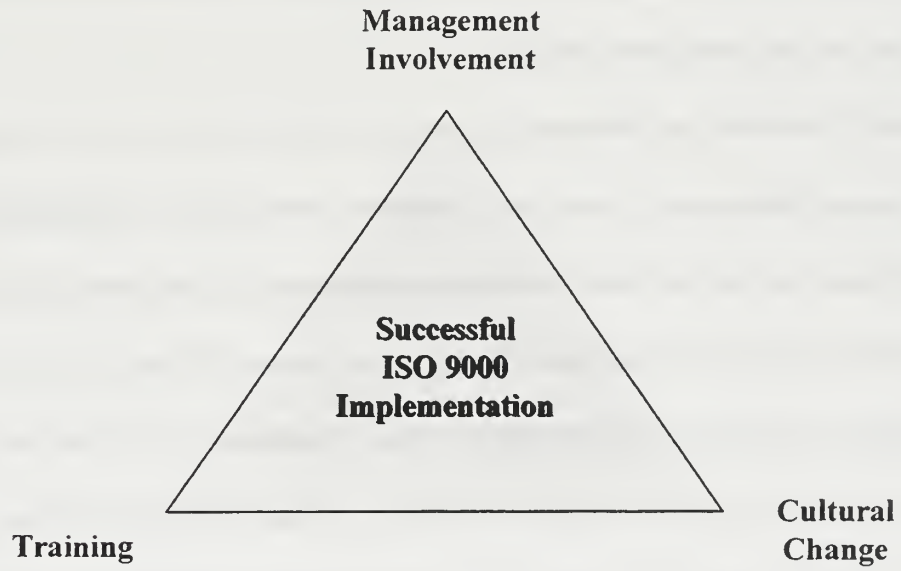

Figure 6. Requirements for Successful Implementation of ISO 9000.

The first cornerstone is the necessity of management involvement in the implementation process of ISO 9000. Management involvement should start at the

beginning of the process and remain a factor for the entire time an organization wants ISO 9000 certification. Within an AIMD, management involvement would include the Work Center Supervisors, Division Chiefs, Division Officers, and most importantly the Maintenance Officer (MO). On a broader scale, if every maintenance level within naval aviation were involved, management involvement would go all the way up the chain of command to the Chief of Naval Operations (CNO).

Management involvement is a key motivator for the rest of the organization. It will give a strong signal to personnel that ISO 9000 implementation is important and not just the "flavor of the month" quality system concept. If management actively promotes the importance of ISO 9000 and that it is here to stay, sailors throughout the department will strive for successful implementation.

According to Professor William Haga, Senior Lecturer at the Naval Postgraduate School, an organization needs a "champion" whenever a new system is implemented [16]. A champion is a senior management representative that actively promotes a new system or concept within an organization. This representative is the focal point and leader for a successful implementation of ISO 9000. Within an intermediate maintenance activity, the QAO is the logical choice for a champion. H/She is already involved in the assurance of quality systems for the activity, and could easily assume the role of ensuring ISO 9000 implementation for the maintenance activity.

The next requirement for successful ISO 9000 implementation is training. Every person within the maintenance activity must receive ISO 9000 training, from the MO to

the Airmen. Without training, sailors in the work center will not understand their role within the ISO 9000 QMS, which is to continuously strive for process improvement and identify deficiencies [14].

An example of a training course is one that is given to all personnel at NADEP Cherry Point. The Depot requires all personnel to attend a 40-hour ISO 9000 familiarization course [12]. This course describes all of the tenets of ISO 9000, and what is expected of every employee for successful implementation. At the end of the course, personnel are motivated and ready to incorporate ISO 9000 into their existing quality system. [12]

Good training leads to increased quality. Training can instill a sense of responsibility and pride for the work that needs to be accomplished. This leads to the last requirement for successful ISO 9000 implementation, wiliness for cultural change.

Management involvement and training will not work unless there is also a willingness for cultural change. As stated earlier, the NAMP is a top-down approach, which gives little flexibility to personnel trying to implement changes to policies and procedures. ISO 9000 is a bottom-up system, which requires personnel and management to work together and identify deficiencies on processes they work on. These two approaches to a quality system are different.

The current quality system may make it easier for sailors to remain unmotivated and wait for directives from their Division Officer or Chief. Officers within naval

aviation state that deficiencies revealed by internal audits are fixed temporarily. During subsequent internal audits, the same deficiencies are often found. [17]

Under ISO 9000, the mentality is once a deficiency is found the problem is corrected at the root cause and prevented from happening again [3]. The only way this change in culture can happen is through training and active management involvement. As stated earlier, all three of these requirements- management involvement, training, and cultural change are dependent upon each other.

H. CHAPTER SUMMARY

This chapter explained why implementation of ISO 9000 is necessary for improving naval aviation's quality system. This was determined by analyzing the NAMP's organizational and intermediate level maintenance process maps and the ISO 9000 process map, and how the ISO 9000 QMS would improve and build on the NAMP's current quality system. Lastly, the requirements for successful ISO 9000 implementation into naval aviation organizational and intermediate maintenance were discussed.

The next chapter analyzes the twenty ISO 9000 tenets, and determine what the NAMP's Tool Control Program must do to reach ISO 9000 compliance.

III. THE TWENTY ISO 9000 QMS TENETS

A. INTRODUCTION

This chapter explains the twenty tenets of the ISO 9000 Standard and why it is necessary for each standard to be implemented. Each standard is listed individually in this chapter and broken down to key points. The tenets are then compared to the Tool Control Program to determine if the NAMP meets these requirements and if not, what must be done to satisfy the specific requirement. The entire ISO 9000 Standard is listed in Appendix B and a sample quality manual for the Tool Control Program is in Appendix C.

B. THE ISO 9000 STANDARD

The ISO 9000 Standard consists of twenty tenets that must be met in order for an organization to become compliant. The entire standard contains 156 "shalls" that must be in compliance during the audit process. Registrars hired by the organization seeking registration carry out assessments of each tenet. Each of the twenty tenets relates to specific areas necessary for satisfying customer needs. Each tenet is geared toward customer satisfaction and no tenet is more or less important than another. An organization cannot pick and choose certain standards to follow and expect successful implementation. However, there are situations which allow certain tenets to be omitted that do not apply to your organization. Omission of a standard, however, does not grant the organization the ability to skip that tenet during the audit process. Each tenet is reviewed during the audit process to determine if that tenet must indeed be met. This review is due to the constant

changes of policies and procedures of an organization, and is a check to make sure that the tenet still does not need to become an integral part of an organization. [18]

In the following tenets, "Supplier" refers to the organization implementing the standard. In this case, supplier will mean either an organizational level aircraft squadron or an Aviation Intermediate Maintenance Department (AIMD).

C. TENET 4.1: MANAGEMENT RESPONSIBILITY

The first tenet in the ISO 9000 standard deals with management responsibility. This tenet places overall responsibility of an organization's quality policy on the upper management of an organization [14]. This would be the Commanding Officer (CO) of a squadron, the Maintenance Officer (MO) of an AIMD and ultimately all the way up the chain to the head of Aviation maintenance at Naval Air Systems Command (NAVAIR). Also, the individuals that are authorized to change a system or process are upper management and if the change to a system or process results in improvements or if quality is jeopardized, upper management is ultimately responsible. This section of the tenet insures that the personnel that are authorized to make such changes to systems or processes are ultimately responsible for the entire quality system. The bottom line is that responsibility for quality starts with the person "at the top". [12]

The NAMP does assign responsibility to upper management. In Naval Aviation, the overall responsibility is with the Chief of Naval Operations, as stated in Chapters One and Two of Volume I. Also, the NAMP directs overall responsibility to the Commanding Officer of an activity and follows the military chain of command. Volume I, Chapter 11

of the NAMP states that the CO has overall responsibility and is responsible for the inspection and quality of material under their cognizance. [2]

A responsibility is an obligation to perform the duties of the job or to achieve a desired condition. On the other hand, authority is the right to make a decision or take an action. As stated earlier, the CO has overall responsibility of an organization's actions. However, everyone within an organization shares responsibility for achieving the desired goals. Authority is given to subordinates of an organization to take control of their responsibility.

The Tool Control Program has very specifically outlined the responsibilities and authorities of every person involved within the process. In Volume V, Chapter 13, the Tool Control Program (TCP) states job descriptions and procedures for everyone involved within the TCP process [2]. Therefore, no change would be needed to make the TCP compliant with this tenet.

This tenet of ISO 9000 also requires that organizations provide adequate resources including human, financial, and material to implement the quality system [14]. This may require resource utilization records to be maintained in order to demonstrate that adequate resources have been allocated to implement the quality system.

Within the NAMP, there is no such statement that guarantees adequate resources will be provided to implement a quality system. Manning, budgets, and materials are usually determined at higher levels within the Navy and are not in the Commanding Officer's direct control. In order for successful implementation of the International

Standard, the CO must direct manning and budget dollars allocated for different programs to be used for ISO 9000. This may cause other programs to be hurt in the process.

For successful implementation within naval aviation, the Navy needs to make sure sufficient budget dollars and manning are allocated to ISO 9000. The specific amount of budget dollars and manning needed for successful ISO 9000 implementation into the O and I-levels of naval aviation is beyond the scope of this thesis and could be the subject of further thesis research.

A management representative is also a requirement of this tenet [14]. A management representative should be well versed on quality issues. This person should only report to the CO or MO so that there would be no conflicts of interest within the organization. This person must also be able to exert authority over other managers on quality system issues. The management representative must have the right to do several things including:

1. Report on the quality performance of a system.
2. Be a liaison with external bodies on quality matters.
3. Determine whether proposed policies and practices meet the requirements of a standard.
4. Identify and manage programs for improvement in the quality system. [12]

Currently, naval aviation does not have a management position that fits this requirement. Upon implementation of ISO 9000, organizational and intermediate levels must adapt this requirement into its current structure. The best fit for this job would

probably be the Quality Assurance Officer (QAO). The QAO would be able to adapt current job responsibilities to meet ISO 9000 requirements, since s/he is already involved in the management of the organization's quality system.

The last section of management responsibility standards deals with management review. The purpose of management review is to determine if the quality system is effective and if it is suitable to continue without change. Initial management reviews should be frequent (e.g., monthly, semi-annually) until it is established that the system is effective. Once the system is determined to be effective, management needs to define the needed interval between internal audits. [12]

Review of the quality system is an important process. Once an organization is ISO 9000 certified, it cannot breathe a sigh of relief and stop striving for improvements. Within the NAMP, organizations are required to perform quarterly internal audits on programs. The requirement to review the quality system can be included in the current quarterly audits. The Computerized Self-Evaluation Checklists (CSEC) are audit checklists to make sure programs within the NAMP are in compliance. These checklists can be modified to include internal ISO 9000 checks to help ensure the organization is following the standards.

D. TENET 4.2: QUALITY SYSTEMS

The second tenet in the International Standard deals with the quality system. A quality system is a management-driven, facility and process wide program of plans, activities, resources, and events. It is implemented and managed with the aim of ensuring

that process output will meet customer quality requirements while ensuring that only value-added processes are used. The goal of a quality system is to enable organizations to achieve, sustain, and improve quality economically [12].

As shown in Figure 6, a quality manual is at the very apex of a documented quality system. A quality manual lists the basic policies on how to run an organization. It contains information on how the organization will comply with each of the twenty tenets. A quality manual does not need to go into very detailed procedures or instructions. It just gives a brief overlay of how your organization does processes as demanded by the International Standard. A quality manual, however, must include or make reference to the system procedures and outline the structure of the documentation used in the system. A good quality manual is no more than 20-30 pages. [12] A sample quality manual is in Appendix C. The design of the manual was taken from a quality manual issued by the Naval Aviation Depot Cherry Point, N.C. for their ISO 9000 registration. The manual has been modified by the author to fit naval aviation intermediate-level maintenance.

The second tier is quality procedures. These are the organization's documented procedures of a process. [12] Most procedures for the Tool Control Program are listed in Volume V, Chapter 13.4 of the NAMP. For example, one procedure is that tools used within a squadron or AIMD must be properly etched with the organizational code and work center. [2]

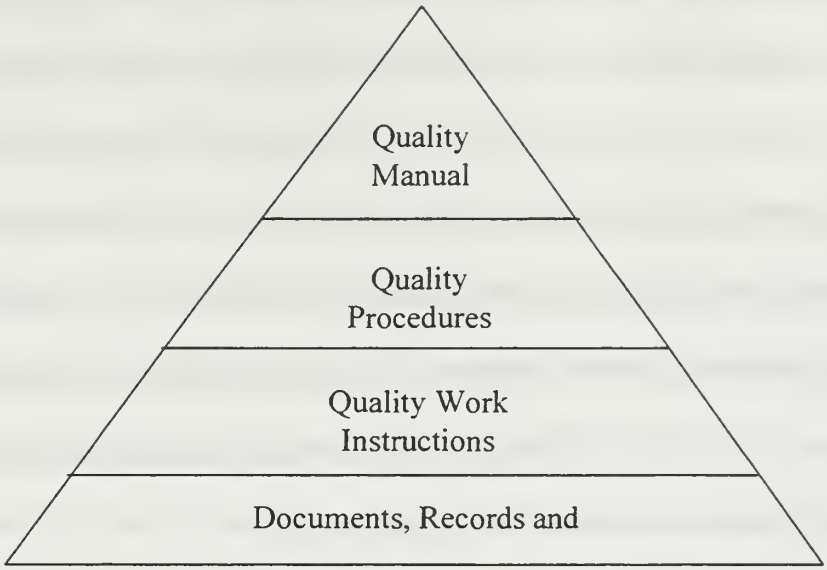

Figure 7. ISO 9000 Documentation System Structure. From Ref. [12].

Work instructions are the third tier of a documented quality system. These instructions are usually at the work center, and give instructions on how to do a specific task. [12] Using the prior example, the requirement for etching tools is stated in the procedures, but how to etch the tools is found in work instructions.

The fourth tier is comprised of documents, records, and forms. It is at the bottom of the pyramid because it takes up the biggest part of a quality system. Its main purpose is to document that everything above it is being done. One of the basic sayings of ISO 9000 is "Say what you do, do what you say, and show me how you know you're doing it right." Procedures and instructions tell an organization what to do, but documents, records, and forms prove that the process is in compliance of the standards. [12]

The NAMP mandates that O or I-levels keep records of certain forms that are required by the TCP. For example, the Missing/Broken/Worn Tool Report (Appendix D)

is a major form that needs to be filled out when a tool needs to be replaced. Once completed, the NAMP states that the TCP Coordinator is responsible for maintaining a record of this form. Another example is of the use of the Tool Container Change Request form. This form is used to request approval to add, delete, or modify tool containers. [2] Both of these forms become vital documents when used, as it proves that a required process or procedure has been completed. Under ISO 9000, these documents must be kept as a record. The ISO 9000 standard does not specify how long records are maintained, just that records shall be maintained. [18]

Other documents, such as VIDS/MAFs and Tool Container Shortage Lists, are kept as records within the TCP [2]. These forms also prove that a required process or procedure has been met, thus they meet the ISO 9000 standard.

E. TENET 4.3: CONTRACT REVIEW

The third tenet in the International Standard deals with contract review. This section of the tenet deals with contracts placed on the supplier by the customer. Contracts placed by the supplier on a sub-contractor are discussed in Section 4.6 (Purchasing). A customer is any organization or activity that has a written or verbal contract with the supplier to perform a specified task. Customers can be either internal or external. [18] An internal customer for the TCP would be the individual work centers requesting new tools with the Missing/Broken/Worn Tool Report. In this example, the TCP Coordinator is the supplier, while the work centers are the internal customers. There are really no external customers for the TCP, just varying degrees of internal customers. Other examples of

internal customers for an I-level TCP would be the squadron or Supply Department awaiting a good part. For an O-level TCP, an internal customer is the aircrew awaiting a Foreign Object Damage (FOD) free aircraft.

This tenet states that an organization must establish and maintain documented procedures for contract review and the coordination of contracting activities. Contract procedures between the supplier and customer need to define how potential customers place orders and how changes to contracts are initiated [42].

The three main interactions between the TCP Coordinator and work centers, as outlined in the NAMP, are requesting replacement tools, checking out tools, and changes or deviations to tool containers [2].

The TCP does not specifically give procedures for requesting a new tool. Section 13.4 of the TCP gives procedures for replacing missing tools, but does not give procedures for replacing broken or worn tools [2]. In order for the NAMP to become ISO compliant, additions to this section must include procedures for requesting a new tool from the TCP coordinator.

Procedures for checking out tools and changes or deviations to tool containers are clearly defined in the TCP (Section 13.4) [2], and require no changes for ISO compliance.

Another purpose of this tenet is to ensure that customers have confidence in the supplier's ability to understand and satisfy all accepted requirements. In order to build confidence with the customer, the contract needs to be clearly defined. The purpose of the contract conditions such as specific quantities or delivery times and quality assurance

requirements are just some ways to clearly define a contract. If there are any differences between the suppliers ability to perform a task and a customer need, it should be clearly defined in the contract [14].

The TCP uses a standardized form to request new tools. This form, when filled out correctly, forms a contract between the TCP Coordinator and the work center. Once the form is submitted, the TCP Coordinator has an obligation to satisfy the request of the work center by supplying a new tool. If the tool is out of stock, then the TCP Coordinator orders the tool, and informs the work center of the status.

This is just one example of the many ways a contract is formed between a supplier and a customer. Many contracts are formed everyday within naval aviation. To study each one of the internal and external contracts formed would be beyond the scope of this thesis.

F. TENET 4.4: DESIGN CONTROL

The fourth tenet of the ISO 9000 Standard is Design Control. Design Control is a tenet that only applies to organizations that designs new products or manufacture goods [12]. Organizational and intermediate aviation maintenance activities within the Navy do not design new products or manufacture goods. Because Design Control is not relevant to organizational or intermediate level maintenance, it is not discussed.

G. TENET 4.5: DOCUMENT AND DESIGN CONTROL

The fifth tenet of the International Standard is Document and Design Control. In essence, this tenet states that an organization must keep track of all quality documents and data, and make sure the right people review and have access to the latest versions of them. An organization must have written procedures to control all the documents and data in the organization that affect quality.

There are two types of documents in any organization, controlled and uncontrolled. Controlled documents refer to any type of document that is referred to in the published policies and procedures and are essential to the achievement of quality [14]. The NAMP refers to many documents in the TCP. Forms such as the Missing/Broken/Worn Tool Report, Tool Container Shortage List, and Tool Control Manual Change/Deviation Request are listed in the NAMP and are essential to quality. Therefore, these forms must be controlled. The NAMP does have procedures in place to document and record these forms, so it is in compliance with ISO 9000. Examples of these forms are found in Appendix D.

Uncontrolled documents are just the opposite of controlled documents. They are any document not referred to in the published policies and procedures and therefore are defined as not essential to the achievement of quality. Some examples of uncontrolled documents are personal notebooks, diaries, calendars, personal memoranda, and personal letters. An organization is allowed to have uncontrolled documents, but must specify them as such. Care must also be taken in using uncontrolled documents. For example, the

TCP Coordinator may have just received a new tool catalog, which is now the new controlled document. This catalog contains updated information, such as new serial numbers or styles, and replaces the old tool catalog. The old tool catalog, however, may contain important information for existing tools that the squadron or AIMD uses. In order for the work center to keep the old catalog for reference purposes only, it must be clearly labeled as "uncontrolled". [12]

Uncontrolled documents must also not be used for quality purposes. For example, personal notebooks outlining the required steps of a maintenance action are not allowed under ISO 9000. Use of personal notebooks by personnel leads to "shortcuts" and is a big problem in maintaining Quality Assurance. [12] Also, an instruction or procedure may have changed, but workers who use personal notebooks may not know of the change. Current policy and procedures within the NAMP require personnel to check instructions before doing a maintenance action [2], but getting sailors to comply with this is difficult. As stated in Chapter II, this is a cultural problem that must be addressed in order for ISO 9000 implementation to be successful.

This policy also applies to new revisions of instructions. Procedures must be in place to get rid of old instructions and replace them with the latest revision or change. Additionally, the organization must also ensure that the old copies are destroyed and the issuing authority maintains a record of the changes. Currently, the QA division of a squadron or AIMD is responsible for updating documents. The NAMP outlines QA's responsibilities in Volume 1, Chapter 14. It states that a Central Technical Publication

Library (CTPL) be maintained, and that all revisions and changes to instructions must originate from there [2]. To comply, a CTPL maintains a document record index, which is a list of documents denoting issue status and location.

Ultimately, it is the user's responsibility to ensure that the correct document is being used. Before an instruction is referenced, the user should ensure that it is the latest revision. One way to do this is to include this step in the procedures. It is very important to maintain current documents within the TCP. The NAVAIR 17 Series is a list of instructions for the various tool containers in naval aviation. It gives instructions on how various tool containers should be silhouetted and laid out. Currently, when sailors access this document, they do not have to ensure it is the latest revision. In order for the NAMP to comply with ISO 9000, a change must be made to ensure that the most current instruction is used.

The more documents in circulation, the more chance there is that the documents will not be maintained properly. ISO 9000 does require that documents be kept under lock and key. It does mandate that access to documents be limited to those who have a need to know. For example, work center instructions may be kept in a work center onboard a ship, but the space should be locked when no one is there. This ensures that only authorized personnel, the sailors of the work center, have access to the documents.

H. TENET 4.6: PURCHASING

The next tenet deals with Purchasing. The tenet is similar to Section 4.3, Contract Review, but instead of covering orders and contracts for what goes out to customers, it covers purchase orders and contracts for what comes in from vendors.

This tenet states that an organization must have a system in place for selecting vendors and to ensure purchase orders are complete and accurate before they are sent to vendors [14]. The organization must have written procedures for making sure that products and services purchased from vendors meet all requirements listed in the tenet (correct product, quantity, and quality) [19].

Squadrons and AIMDs within the Navy are required to utilize the Navy Supply System for procurement of all supplies and services. This policy is in place to help ensure that the right item is purchased when needed. The Navy Supply System tries to ensure that the right product is being purchased and at the best value. If a squadron or AIMD were allowed to seek its own vendors, the integrity of the maintenance process would be at risk. This is due to the unknown engineering factors by maintenance personnel, such as reliability or compatibility of the tool purchased, which effect the finished product.

At the squadron or AIMD level, the TCP Coordinator requires a Broken/Missing/Worn Tool report to replace a work center's tool. This check guarantees that the right item is replaced, requiring a one-for-one replacement (unless the tool is missing, then the MO must grant permission). Additionally, tools purchased must be in the NAVAIR Series 17 manuals. These manuals list which tools can be purchased for

work on aircraft, and list exactly what must be in every tool container for a Type Model Series aircraft (T/M/S) [2].

To comply with the purchasing section of the tenet, a squadron or AIMD must verify requisition requests for new tools. Currently, the NAMP requires verification of tool requisitions by the Program Manager. Upon ordering new tools, the TCP Coordinator must use the DOD Single Line Item Requisition System Document (DD 1348). This is a standard ordering form used to requisition any type of item throughout the Navy. The NAMP requires the Program Manager of the TCP to verify all requisitions submitted by the TCP Coordinator. It states the Program Manager shall screen all Service Market (SERVMART) shopping lists prior to and at the completion of shopping to ensure no unauthorized purchases are made. Furthermore, the Program Manager must also review all Aviation Fleet Maintenance (AFM) Fund requisitions submitted by the TCP Coordinator for the purchase of replacement and spare tools to ensure unauthorized or excess tools are not purchased [2]. Each of these checks verifies that the right tool, for the right job, at the right time is being ordered. Thus, the TCP is in compliance with this tenet.

I. TENET 4.7: CONTROL OF CUSTOMER-SUPPLIED PRODUCT

Control of a customer-supplied product is the next tenet of the International Standard. The essence of this tenet is that if a customer gives an organization a product to work with, that organization must take good care of it [14]. The inherit nature of naval aviation maintenance requires some sort of a customer-supplied product. Aircraft, support

equipment, and individual aircraft parts are all customer-supplied products for the maintenance department of a squadron or an AIMD. A policy must be in place in order to protect customer-supplied products from getting damaged. The entire TCP section of the NAMP is a list of policies and procedures in place for protecting a customer-supplied product. Tool control helps reduce or eliminate damage caused by FOD in aircraft or support equipment by having accountability of the tool(s) at all times. Since the entire TCP (Volume V, Chapter 13 of the NAMP) focuses on protecting a customer-supplied product, the TCP is in compliance with this tenet.

J. TENET 4.8: PRODUCT IDENTIFICATION AND TRACEABILITY

The next tenet within the International Standard deals with Product Identification and Traceability. This section of the standard, which deals with identifying and tracking product, is the only one that starts with the words "where appropriate." In general, if the process or procedure for a product has a direct impact on customer satisfaction, the product should be identified through specific stages. [19]

There is also a requirement for traceability, which is the ability to go back and identify the particular batches of raw material and processing steps that went into producing the final product. It is only necessary to meet this requirement if an organization's customer requires it, if it is for safety reasons, or if government or industry regulations apply. [19]

The TCP requires product identification and traceability of tools used for maintenance. All squadrons and AIMDs are required to etch as many tools as possible

with the organization code, work center, and tool container number. Additionally, an inventory list within each tool container shall be maintained to help identify missing tools. If a tool is too small to be etched, the inventory list shall identify that tool with an asterisk (*) in the left margin [2]. With these requirements, tools that end up being FOD can be traced back to the originator and proper action can be taken to prevent the occurrence from happening again.

Product identification and traceability within naval aviation is a concern. With proper identification and traceability of customer-supplied products, problems can be traced back to the origin to prevent further occurrences. The TCP does not deal specifically with tracing customer-supplied products, but instead focuses on the prevention of defects to them. Identification and traceability of a customer-supplied product encompasses the entire supply and maintenance process within the Navy, from procurement, repair, and disposal of an item. Due to the breadth of this topic, it is beyond the scope of this thesis and is recommended for further research.

K. TENET 4.9: PROCESS CONTROL

Tenet 4.9 of the International Standard discusses Process Control. It asks the organization to address, describe, and control all routine work flows, tasks, and activities. An organization must be able to show that all processes that affect quality are "under control". [14]

Within the TCP, documented procedures are the main way a squadron or AIMD controls the process of searching for a missing tool. Figure 7 is a process map of a typical

maintenance action and the steps involved if a tool is missing. This process map is not in the NAMP, but can be generated by reading the procedures outlined in the TCP chapter. One way for improvement within the NAMP is to generate process maps of all the major procedures required for aviation maintenance. Process maps are easily readable and gives the reader a clear understanding of the steps required. The procedures for the TCP can be found in the text of the NAMP, but are often not grouped together. One must look under different sections of the chapter to get a complete picture of the procedures. For example, the procedures for missing tools can be found in Volume V, page 13-8 of the NAMP. Step two of the procedure states that the individual reporting the missing tool must initiate a Missing/Broken/Worn Tool report. After initiation of the report it goes through the proper channels as outlined in Figure 7. However, the last mention of the Missing/Broken/Worn Tool Report is in step three, which states that Maintenance/Production Control shall forward the report to QA. There is no mention within the procedures of what must happen to the report after this step. One must look under the TCP Coordinator's Responsibilities section of the chapter (section 13.3) to find out that once QA signs the report, it is forwarded to the TCP Coordinator and maintained in a program file [2].

Another problem within the TCP is the use of forms. The Missing/Broken/Worn Tool Report, Tool Container Change Request, Contractor/Field Maintenance Team Tool Control/FOD Brief and Inventory, Tool Container Shortage List, and Tool Control Manual Change/Deviation Request all do not have instructions on how to fill them out.

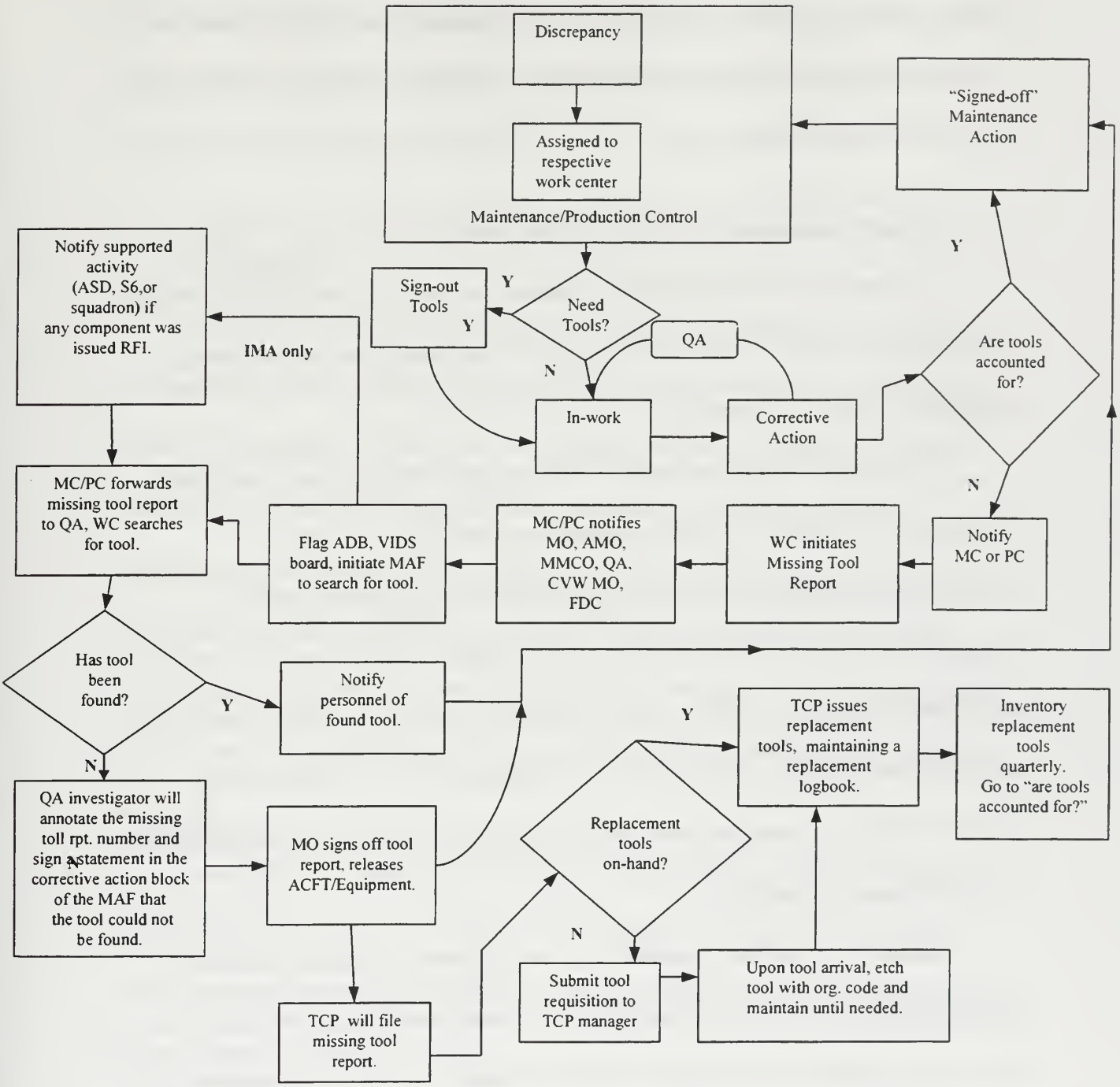

Figure 8. Tool Control Process Map. From Ref. [2].

This can lead to forms that are filled out incorrectly, and can cause quality problems due to misinterpretation. The NAMP must include instructions on filling out forms in order to become ISO 9000 compliant. [14]

L. TENET 4.10: INSPECTION AND TESTING

The next tenet of the International Standard is Inspection and Testing. It requires an organization to have a well-defined system for verifying product as conforming throughout all stages of processing.

Of all the sections of the standard, this one most closely espouses the typical ideals of Quality Control [18]. An inspection is used to discover errors or nonconformances after they occur. This tenet requires an organization to have documented procedures for test and inspection of products and services. This helps to ensure that the customer receives a quality product. Within naval aviation maintenance, inspection and testing is a vital part of everyday affairs. The TCP does require an inspection of all tool containers after every maintenance action and shift change, and after every maintenance action [2].

In addition to test and inspection, this tenet requires an organization to keep records detailing the results of all inspections, including documenting the name of the person responsible for product release. Within a squadron or AIMD, an inspection of all the tool containers is required at the beginning and end of each shift change, and requires documentation using a passdown log. The NAMP also states that a technician or Collateral Duty Inspector (CDI) shall do a sight inspection for tools prior to starting each

task and at each work stoppage. In addition, after maintenance has been completed and before an operations check, an inspection for tools shall be performed [2]. The TCP is well within the requirements of this tenet.

M. TENET 4.11: CONTROL OF INSPECTION, MEASURING AND TEST EQUIPMENT

Tenet 4.11 of the International Standard requires an organization to maintain a very detailed system for keeping inspection equipment accurate and in good operating condition. The integrity of products an organization produces depends on the quality of the devices used to create and measure their characteristics. This tenet covers all inspection equipment that is used to verify the quality of products. All such equipment must be kept identified, calibrated, and in good condition. Additionally, all of these activities must be performed according to documented procedures and work instructions, and of course, an organization must keep records that detail all calibration activities and results. [18]

Controlling of test equipment is not the only thing that is required. The selection and appropriateness of the device used is also important. For example, if a dimension must be measured to the nearest 0.001 inch, then a tool that can consistently measure this amount of tolerance must be used. [19]

Certain tools and Support Equipment (SE) used by squadrons and AIMDs require calibration to ensure accuracy of the procedure. Calibration procedures are mentioned briefly within the TCP. Section 13.4.2 of Chapter 13 states that tools inducted for

calibration must be annotated on the Tool Container Shortage List [2]. This requirement helps ensure accountability for all tools within an organization and is a vital step in the pursuit of a quality product.

The TCP does not focus on calibration of tools, so this tenet does not apply to the TCP. Instead, the Naval Aviation Metrology and Calibration Program (Chapter 19, Volume V of the NAMP), lists the procedures required to induct tools into calibration. Because this thesis focuses on one aspect of the NAMP, the Tool Control Program, the calibration program within the NAMP may or may not be ISO 9000 compliant, and is the subject of further research.

N. TENET 4.12: INSPECTION AND TEST STATUS

The next tenet is a short, but important aspect of the International Standard. This tenet basically states that for any given product at any point in processing, it must be clear what inspections or tests it has been through and what the results were [19].

Most organizations, including the Navy, have established a two-category system in classifying products. The classifications are inspected/passed or nonconforming, and uninspected/nonconforming. This classification sees both product that has failed and uninspected product as nonconforming [19]. For example, a tool that has passed its date for a calibration check is considered to be a nonconforming product. Also, a tool that has failed calibration is considered nonconforming. This tenet also requires the status of an inspection to be maintained throughout the entire production cycle.

The TCP does not require test and inspection of the item a work center is working on, but does require test and inspection on certain tools. Within a squadron or AIMD, a tool that requires calibration must have a clearly marked seal affixed to the tool, stating the date the tool is due for calibration. If the date has passed, the tool is a nonconforming item and may not be used for any maintenance. The calibration seal is also placed over readily accessible calibration/adjustment points. If the calibration seal is broken in any way, the tool is considered nonconforming [2]. The procedures for tools requiring periodic test and inspection are clearly outlined within the NAMP. Therefore the TCP is within compliance of this tenet.

O. TENET 4.13: CONTROL OF NONCONFORMING PRODUCT

A documented and effective system must be used for dealing with any product that does not conform to requirements. Section 4.13 of the International Standard states that an organization must have documented procedures that prevent nonconforming product from being used [14]. A nonconforming product is defined as a product that does not conform to specified requirements. Procedures for control of a nonconforming product must cover: 1) Identifying and segregating (where possible) all nonconforming product to prevent it from being used and 2) a well-defined process for evaluating and determining what should be done with nonconforming product [20].

Broken and worn tools are examples of a nonconforming product within naval aviation. The NAMP does have documented procedures for disposal of nonconforming tools. The NAMP states that the TCP Coordinator must "ensure proper disposal of

broken/worn tools." Additionally, the TCP Coordinator must maintain these tools in a locked container and eradicate all etching from them prior to disposal. This requirement segregates the nonconforming tools from the conforming ones. Tools that are no longer required by a squadron or AIMD are also considered nonconforming. The NAMP requires the TCP Coordinator to attempt to redistribute these tools through the Defense Reutilization Management Office (DRMO). [2]

With procedures in place to ensure broken, worn, and non-required tools are not used for maintenance, the TCP has control of nonconforming products and is in compliance with this tenet.

P. TENET 4.14: CORRECTIVE AND PREVENTIVE ACTION

Corrective and Preventive Action is the ISO 9000 equivalent to total quality management's (TQM) idea of continuous improvement [12]. It requires a procedure to describe an efficient program for corrective and preventive action. It further requires the approaches and solutions chosen to be consistent with the magnitude of the identified problems and opportunities for improvement. The wording in this tenet states the solutions and problems should be "to a degree appropriate to the magnitude of problems and commensurate with the risks encountered." [14, pg. 8] Simply put, don't hit a fly with a sledge hammer [18].

Corrective and preventative actions are intended to eliminate the causes of nonconformities by making corrections to the quality system. Notice the difference between this tenet and tenet 4.13. Control of nonconforming product is about putting

defective product right; corrective and preventive action are about putting the quality system right. Corrective action deals with *actual* problems and preventive action deals with *potential* problems [15].

The TCP within a squadron or AIMD does not deal with corrective and preventive action for a product. A stated earlier in the chapter, all twenty ISO 9000 QMS tenets do not have to be applied for an organization to become compliant. Corrective and preventive actions on aircraft, aircraft parts, and support equipment within naval aviation are dealt with in other sections of the NAMP. Therefore, the TCP is within compliance of this tenet. A recommendation for further thesis research is to study the compatibility of ISO 9000 to other programs within the NAMP.

Q. TENET 4.15: HANDLING, STORAGE, PACKAGING, PRESERVATION AND DELIVERY

From the time material comes in an organization's door until it is no longer their responsibility, the organization must protect it from damage. An organization must have documented procedures that prevent damage or deterioration of product throughout all handling, storage, packaging, and delivery activities. [12]

The main purpose of this tenet is to ensure that a conforming product remains conforming. This includes customer supplied product, non-customer supplied product, and materials used to manufacturer product. [14] The TCP's overarching goal is to ensure proper handling of customer supplied product by prevention of tools becoming lodged

within the product (FOD). This is done by having procedures in place for the proper handling and storage of these tools. [2]

Sections 13.3-13.4 of the TCP outlines the procedures for proper handling and storage of a product. The Work Center Supervisor and Work Center Tool Control Representative are responsible for the general handling and storage of tools within their work center. The TCP states that the Work Center Supervisor shall "ensure tool containers are FOD free at all times." The Work Center Tool Control Representative is also responsible for maintaining the tools and tool containers. In other words, tool containers should be free of any debris, and tools should be wiped down after each use to prevent corrosion. The NAMP also specifies that the Work Center Supervisor and Tool Control Representative shall inspect the tool containers at the beginning and end of each shift [2]. This procedure satisfies the tenet's requirement of "product … shall be accessed at appropriate intervals" [14].

Tools used for Aviation Life Support System (ALSS) equipment require different handling and storage procedures than other tools. ALSS equipment includes ejection seats and parachutes; equipment that requires a very low failure rate when activated. Section 13.4.1 of the NAMP outlines the different procedures required, which include:

1. All tools shall be maintained in a clean, oil and grease free condition.
2. All tools used on oxygen components shall be segregated with the container marked "OXYGEN USE ONLY".
3. Do not etch non-sparking, non-magnetic, beryllium hand tools [2].

The TCP has very detailed procedures in place for proper handling and storage of equipment and is in compliance with the first part of the tenet. The last part of the tenet deals with preservation and delivery of a product. This section does not deal with the TCP, but with other aspects of the NAMP, and is therefore the focus of further research.

R. TENET 4.16: CONTROL OF QUALITY RECORDS

The essence of this tenet is that all records related to an organization's quality system must be handled and maintained according to documented procedures. Most of the other tenets mention the need for records to be maintained. Records are kept as proof that activities occurred and as evidence that can be analyzed later. [19]

A quality record is any document that describes the achieved features and characteristics of a product or service or records that demonstrate that work has been planned, organized, monitored, verified, or corrected [12]. All records are quality records because they provide evidence of activities and tasks performed. This tenet requires that an organization have documented procedures that detail:

1. How records are identified.
2. How records are stored so that they are easy to find and not lost or damaged.
3. Identify personnel responsible for maintaining records.
4. How long the different types of records are maintained. [19]

The procedures within the NAMP require the use of five different forms for the TCP. They are listed in Appendix C. Each form, when filled out properly, becomes a vital

record for the TCP. Each form can then be accessed to prove that a procedure was completed correctly. The TCP's current procedures on quality records are not in compliance with this standard. Control of quality records is the biggest difference between ISO 9000 and the TCP, requiring the most number of changes of the TCP than any other tenet. Procedures established for each form within the TCP are different, so each one will be looked at separately.

The Missing/Broken/Worn Tool Report is a required form whenever a work center needs a new tool because the old tool is missing, broken, or worn. The current procedures identify the TCP Coordinator as the person responsible for maintaining these forms. The procedures also outline that the completed forms be maintained in a program file, but does not establish a length of time for these forms to be maintained. For the NAMP to become compliant, it must establish a length of time to retain these records.

The Tool Container Change Request and Tool Control Manual Change/Deviation Request are forms used whenever a work center wants to deviate or change the outlay of a tool container. Once submitted to the Maintenance Material Control Officer (MMCO) for approval, the TCP specifies that the Work Center Tool Control Representative will maintain the completed forms in a file. Once again, the NAMP does not specify the length of time to maintain these records.

The Contractor/Field Maintenance TCP and FOD Brief is a required form whenever civilian contractors are called upon for maintenance. This form requires a contracting team to follow the NAMP's procedures on tool control. The only mention of

this form within the procedures is on page 13-4. It states that the Quality Assurance Program Monitor shall conduct beginning and final tool inventories with the contracting maintenance team using this form. There is no other mention of this form within the entire NAMP. For the TCP to become ISO 9000 compliant, procedures must be written stating who is responsible for this form, where it is maintained, and the length of time for retention.

The last form used within the TCP is the Tool Container Shortage List. This form is kept in every tool container, and lists which tools are missing due to back-order or calibration. The Work Center Supervisor is responsible for maintaining these forms. However, the TCP procedures do not specify what is to be done with forms that are filled out completely. This means that the forms may be thrown away, and not kept as a record.

The NAMP needs to re-write its procedures on maintaining TCP quality records before it can become ISO 9000 compliant.

S. TENET 4.17: INTERNAL QUALITY AUDITS

The next tenet of the International Standard is Internal Quality Audits. It requires an organization to perform regular and thorough "check-ups" to identify any problems in adhering to the quality system, and to check if the system is really effective in providing quality products and services. [19]

As stated earlier, the purpose of quality audits is to determine whether the quality system is effective in maintaining control to ensure a high quality product is provided to the customer. Quality audits should provide unbiased, factual information on the quality

performance in various components (the twenty tenets) of the quality system. These audits must not be performed to find fault, apportion blame, or investigate problems, but should always be performed on a regularly scheduled basis. Also, someone who has no responsibility for what is being measured should always perform these audits. [12]

For ISO 9000 compliance however, squadrons and AIMDs within naval aviation must train personnel to become internal quality auditors. Quality Assurance department personnel would be the best choice for internal auditors since they currently perform NAMP required audits within the organization. Audits for the quality system can be performed at the same time other regularly scheduled audits are performed within naval aviation.

T. TENET 4.18: TRAINING

This brief tenet requires documented procedures that define how training needs are identified and met for personnel at an organization. It also requires training records to be kept for all personnel. [19]

There are two confusing statements in this tenet. The first wording refers to "personnel performing activities affecting quality." [12, pg. 10] This phrase is misleading because every individual and every activity at some level affects quality. If the tasks and activities performed by an individual do not contribute to an organization's goals and objectives, they are most likely nonvalue-added wastes of resources and should be eliminated. The second statement refers to "personnel performing specific assigned tasks." [12, pg. 10] Every position should have a job or tasks description, and the

individuals working in those positions should be performing those tasks. Organizations should identify every core task and develop reasonable education and training requirements as needed for each individual. [18]

The squadron or AIMD Assistant Maintenance Officer (AMO) is responsible for implementing tool control training. The TCP states that the AMO shall ensure tool control training is included in the activity indoctrination program for all personnel and shall schedule follow-on tool control training as necessary. Further, the TCP states that the Tool Control Program Coordinator will provide this command indoctrination and follow-on tool control training. [2] However, the NAMP does not specify what this training will be, or require documentation of this training. For compliance, the TCP must specify what each person in the work center needs to know. This training needs to include proper procedures for maintaining tools, accounting for tools after maintenance and shift changes, and what to do when a tool is broken, missing, or worn. Squadrons and AIMDs certainly include this as part of the training, but the NAMP does not spell it out. Without structured training procedures, activities can interpret and adopt their own practices, leading to variances in quality. Also, proof of this training is required. Again, most activities probably document their training, but this is not because the NAMP requires documentation. In order to become ISO 9000 compliant, the NAMP must include specific training requirements and require documentation.

U. TENET 4.19: SERVICING

The briefest tenet of the International Standard is Servicing. If an organization provides servicing of the product it produces, it must have documented procedures that describe how service is performed, verified, and recorded. This primarily applies to manufactured products in the form of warranty repair. [18]

This tenet does not have any applicability to the TCP. The TCP does not provide servicing to any product within naval aviation. Since this tenet does not apply, the TCP is considered to be in compliance with this standard.

V. TENET 4.20: STATISTICAL TECHNIQUES

The last tenet within the International Standard is Statistical Techniques. If an organization needs statistical techniques to get a quality product, then it must have documented procedures for these activities [19].

Statistical techniques can be used for any operation that uses statistical theory to reveal information. This tenet does not require that statistics be used. It requires only that consideration be given to use or not to use.

If statistical techniques are implemented in an organization, process procedures need to be implemented. These procedures need to identify criteria such as; when to use, sample sizes, collection methods, plotting procedures, and guidance for analyzing, interpreting and decision making.

The TCP does not use or require statistical techniques. As stated, this tenet does not require the use of statistical techniques, but requires consideration. The sample

quality manual in Appendix C outlines the policy for statistical technique implementation in a squadron or AIMD TCP.

W. CHAPTER SUMMARY

This chapter explained the twenty tenets of the ISO 9000 Standard and what steps are necessary for each standard to be implemented into the NAMP's Tool Control Program. Each standard was listed individually in this chapter and broken down to key points. The tenets are then compared to the Tool Control Program to determine if the NAMP meets these requirements and if not, what must be done to satisfy the specific requirement.

The next chapter presents a summary of the findings of this thesis. First, the conclusions made from this research are listed and their significance is briefly explained. Next, the recommendations for changes to the Tool Control Program in naval aviation organizational and intermediate maintenance are presented. Finally, topics that are not included in this thesis but which are important to this area of research are recommended for further study.

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IV. CONCLUSIONS AND RECOMMENDATIONS

A. CONCLUSIONS

The data presented in Chapter I show that naval aviation maintenance has not seen a significant improvement in maintenance processes. Class A mishap rates and TFOA rates have reached a plateau in recent years. Although aviation maintenance is just one factor that affects mishap and TFOA rates, any level of improvement in maintenance processes may have a positive and measurable impact on these metrics of aviation safety.

Retention rates of aviation-rated sailors have been decreasing in recent years. One factor for decreasing retention rates is the longer working hours that sailors must work. Even with longer working hours, mishap rates and TFOA rates have stabilized. This is evidence that there is room for naval aviation maintenance to become more efficient.

Other industries, such as the automotive industry, have given us evidence that the ISO 9000 QMS improves the maintenance process. The ISO 9000 QMS has the potential to improve the NAMP's current quality management system in the following ways:

1. The current quality management system of the NAMP does not give direction or detail on how to attain continuous process improvement. This omission is a driving factor behind naval aviation's inability of improving the quality system, as evidenced by the plateau in quality levels. Internal audits performed by the organization do not require the Division Officer of Chief to find the root cause of the deficiency. The ISO 9000 QMS requires intermediate maintenance activities to perform continuous

review of critical process points, corrective actions, and outcomes, and also require Officers and Chiefs to search for the root cause of the deficiency.

2. ISO 9000 could give Officers, Chiefs, Petty Officers, and Airmen a sense of ownership with the work they do by giving them a greater opportunity to improve processes. This sense of ownership is fostered because ISO 9000 facilitates personnel involved in a process or procedure to fix the deficiency. Petty Officers and Airmen could work alongside upper management to find the root cause of the deficiency, and as a result may feel they own the process. The NAMP, on the other hand, provides limited flexibility for improving programs and procedures. As a result, sailors do not feel they own a process and often wait until told to do a task.

3. A strength of the NAMP is its Quality Control procedures, which provide oversight on maintenance actions within naval aviation. ISO 9000 will provide the opportunity for organizations to incorporate Quality Assurance and insight with the NAMP's existing QC procedures. These two quality management systems working together may provide a more efficient maintenance effort at all levels of naval aviation maintenance.

4. Document control is stringent under ISO 9000. Standardized procedures must be in place for all types of documents and records within a process. As a result, deficiencies are easier to identify because of good record keeping. The NAMP, as identified in the gap assessment of the Tool Control Program, does not give specific

guidelines on the handling and storage of certain documents and records. This causes deficiencies to be harder to locate, identify, and solve.

5. ISO 9000 requires the documentation of process flows. This requirement helps an organization see a process and determine if a step within the process adds value. It would also help Officers and Chiefs locate and identify deficiencies within a process. The NAMP does not provide process flows. It only provides the basics for establishing procedures and responsibilities for the accomplishment of maintenance, which are located throughout different sections of the NAMP. Process flows will also streamline the NAMP by organizing the steps and responsibilities of a procedure in one place. This will allow the user to read the procedure without flipping through sections of the NAMP to find the next step of a process.

6. ISO 9000 would save naval aviation money by helping organizations to eliminate waste. Procedures within ISO 9000 require activities to eliminate excess materials that are no longer required. Excess material takes up space, increasing storage costs for an organization and requiring man-hours to take care of the material. The NAMP has no guidelines for excess resources on-hand, which allow organizations to maintain "thirty-year bins".

7. ISO 9000 requires audits to be performed by external auditors. Such audits will give organizations an honest assessment of what needs improvement within their quality management system. The NAMP's current quality system only requires auditors

from a different work center or division when performing CSEC audits. This may lead to a biased audit if the entire organization is affected by the audit results.

8. ISO 9000 is seen as a symbol of commitment. Organizations throughout the world generally accept ISO 9000 as a good business practice. ISO 9000 implementation into the Navy would likely help to attract more desirable contractors and ultimately weed out less desirable ones because of the increased demand for quality. Also, ISO 9000 implementation would help the Navy with joint military endeavors. Programs such as the Joint Strike Fighter with the USAF may be able to have inter-service exchanges of spare parts as a result of ISO 9000 implementation in both services.

9. Lastly, in order for an aviation maintenance activity to be successful at ISO 9000 implementation, the activity must have management involvement, training, and willingness for cultural change. Management must be actively involved in the implementation process from the start. This involvement would indicate to the rest of the activity the importance of ISO 9000. Training must be given to every sailor of the activity, from the MO to the most junior Airman. Training would allow sailors in the work center to understand their role within the ISO 9000 QMS, which is to continuously strive for process improvement by identifying deficiencies. A willingness for cultural change must be present. ISO 9000 is a bottom-up system and the NAMP is a top-down system. Because of this, cultural change must start from the top, through management involvement.

B. RECOMMENDATIONS

ISO 9000 should be implemented into all aspects naval aviation, and ultimately, the rest of the Navy. In order for this to be accomplished, the NAMP must be revamped to fit the ISO 9000 requirements. The gap assessment done between the NAMP's Tool Control Program and ISO 9000 revealed that no major changes were required for the NAMP to become ISO 9000 certified. The following is a list of requirements that naval aviation organizational and intermediate maintenance activities must incorporate in order for the NAMP's Tool Control Program to become ISO 9000 compliant.

1. The NAMP must include a statement that guarantees adequate resources will be provided to implement a quality system, and ensure that adequate resources are provided. Without adequate funding or resources, ISO 9000 may not be implemented successfully.

2. Each maintenance activity must appoint a management representative who will be in charge of implementing ISO 9000. The Quality Assurance Officer of the maintenance activity is a logical choice for this position.

3. Once ISO 9000 is implemented into an activity, the activity must conduct reviews of the quality system. This review can be incorporated into the current audit system of the maintenance activity, and be conducted at the same time as regular CSEC audits.

4. The NAMP needs guidelines for developing a quality manual. The quality manual lists the basic policies of how to run the activity. The management representative would be the one responsible for developing a quality manual.

5. The TCP does not give procedures for requesting a new tool, an important process for accountability of tools. Without proper accountability of tools, tools can be lost or misused for the wrong maintenance action.

6. The TCP procedures for using tools for maintenance must be changed. The procedures within the TCP do not require sailors to make sure the NAVAIR 17 Series list of instructions are the most up to date. This could result in the wrong tool being used.

7. Instructions are required for any form used within the NAMP. The TCP does not give instructions on how to fill out any of the forms in Appendix D. Improperly filled out forms can lead to incorrect data analysis and possibly wrong decisions.

8. The TCP does not specify a length of time for maintaining completed Missing/Broken/Worn Tool Reports, Tool Container Change Requests, and Tool Control Manual Change/Deviation Requests. Without requirements for maintaining forms, activities are free to dispose of these forms upon completion. These forms may help activities analyze past trends in maintenance, and possibly improve maintenance practices.

9. The TCP does not specify who is responsible for the Contractor/Field Maintenance TCP and FOD Brief form, where it is maintained, and the length of time for

retention. Without these procedures in place, contractors may not be properly briefed, possibly causing FOD on equipment worked on.

10. The TCP does not give procedures on what to do with completed Tool Control Shortage Lists. This may lead to the form being misplaced or reused, and also possibly causing lost tools to go unnoticed.

11. The TCP does not specify what tool control training is required for sailors. It also does not require documentation of this training. Without proper training guidelines, activities are free to choose what level of training is adequate. This may lead to variances of quality among different activities.

All of these discrepancies within the Tool Control Program must be fixed in order for the NAMP to become ISO 9000 compliant in this section.

C. RECOMMENDATIONS FOR FURTHER STUDY

The following are recommendations for further study on implementation of ISO 9000 into naval organizational and intermediate maintenance activities.

1. A squadron or AIMD should go through the registration process. Performance metrics, such as mishap rates, Partial or Full Mission Capable (PMC/FMC) rates, cannibalization rates, and retention levels of personnel should be measured against non-ISO squadrons or AIMDs and compared to see if there is improvement.

2. The specific amount of budget dollars and manning needed for successful ISO 9000 implementation could be studied. Specifically, how much would it cost to

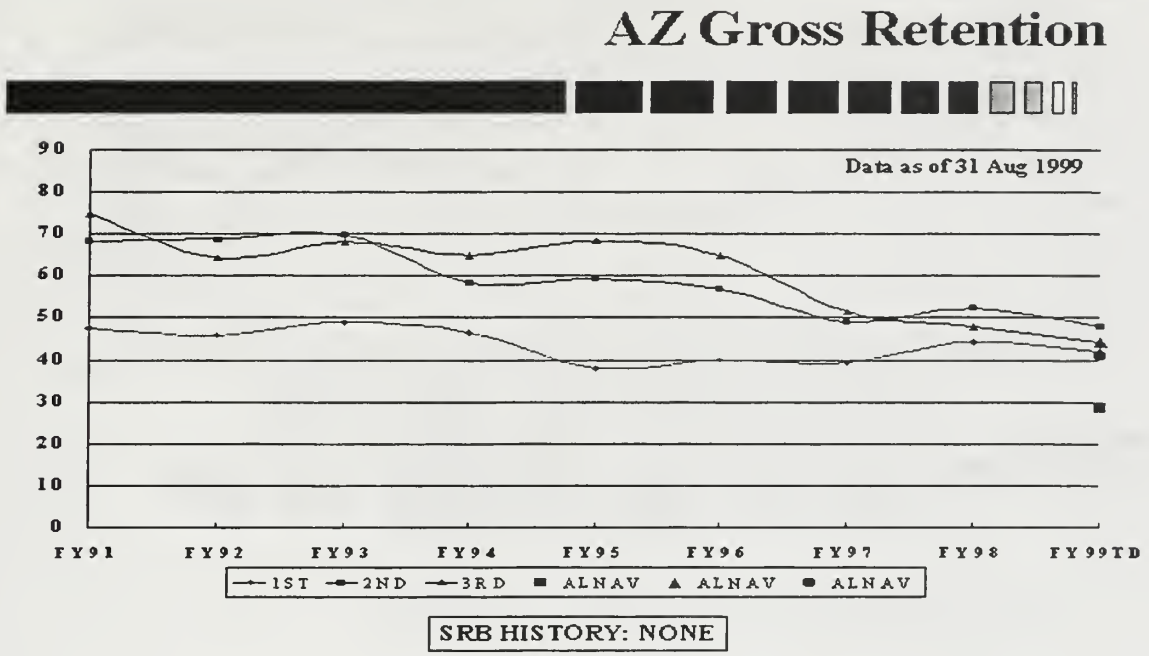
implement ISO 9000 into all activities of naval aviation, and whether the benefits of implementation exceed costs?

3. A study of other programs within the NAMP, such as the Calibration Program, to determine the feasibility and ease of ISO 9000 implementation.

4. Could naval aviation stand on its own in terms of ISO 9000 compliance, or does the Supply system within the Navy also need to become compliant? The identification and traceability of a customer-supplied product encompasses the entire supply and maintenance process within the Navy, from procurement, repair, and disposal. Is it feasible for just the maintenance aspect to become ISO 9000 compliant without including the supply process?

Naval aviation organizational and intermediate level maintenance can become more efficient in its maintenance processes. The NAMP's current quality system has not seen improved levels in maintenance rates in recent years. ISO 9000 is a quality management system that will blend with the current system, building on existing practices and possibly improving outcomes. Naval aviation should seriously consider implementation of ISO 9000. However, ISO 9000 implementation will not guarantee that naval aviation will improve maintenance processes. It will, however, create a greater opportunity for more efficient maintenance practices, something that currently does not exist in naval aviation.

APPENDIX A. RETENTION FIGURES FOR SELECTED AVIATION MAINTENANCE RATINGS. FROM REF. [7].



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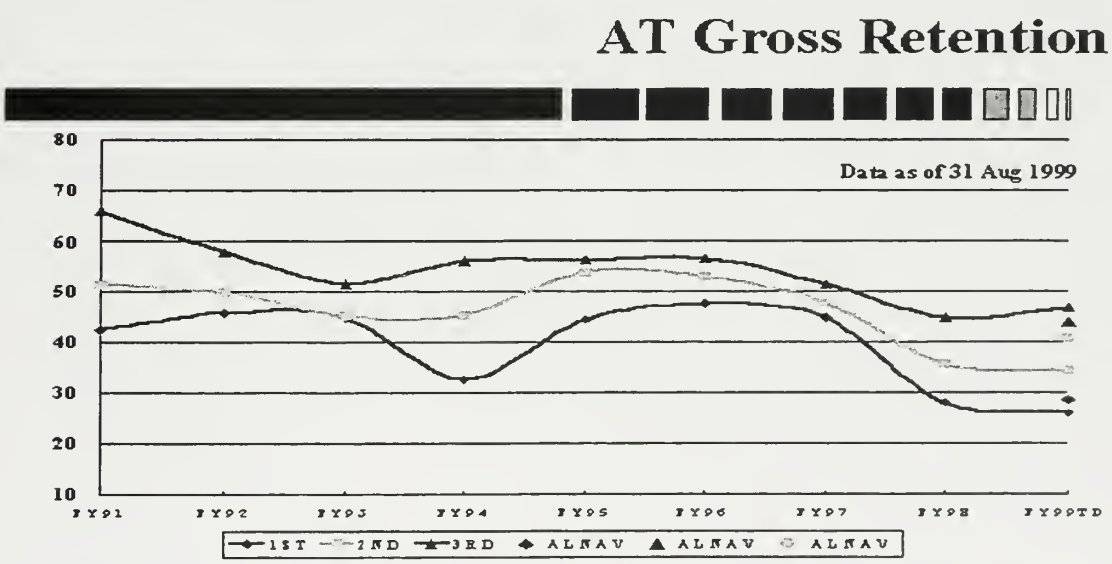

SRB HISTORY

FEB 92	JUL 92	JAN 95	MAY 95	DEC 95	MAY 96	SEP 96	JUL 97	JUL 98	DEC 98	MAY 99
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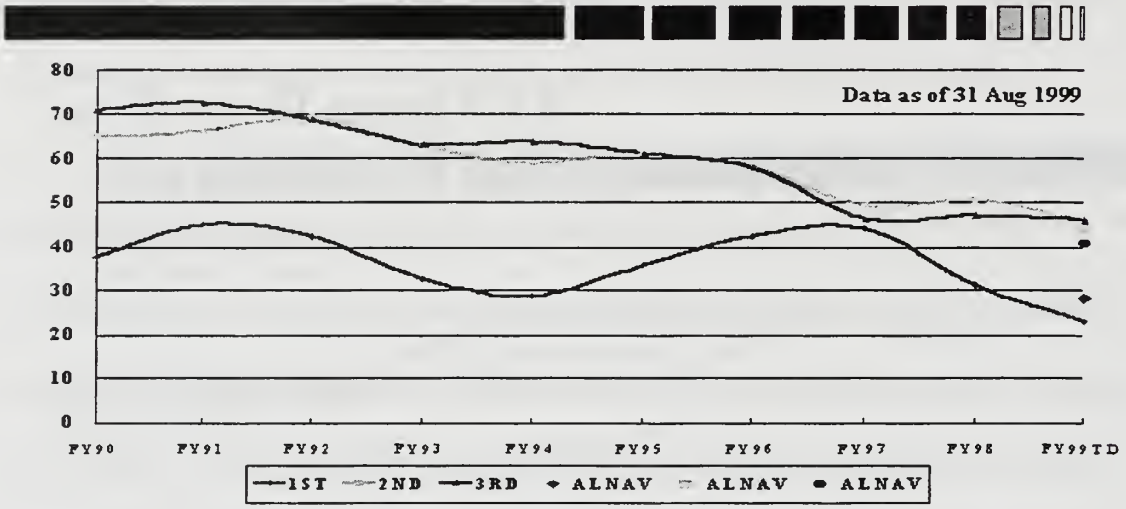
AE Gross Retention



SRB History

MAR91	FEB92	JAN95	MAY95	DEC95	MAY96	SEP96	JUL97	APR98
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INTERNATIONAL STANDARD

ISO 9001

Second edition
1994-07-01

Quality systems — Model for quality assurance in design, development, production, installation and servicing

Systèmes qualité — Modèle pour l'assurance de la qualité en conception, développement, production, installation et prestations associées

Contents

Quality systems — Model for quality assurance in design, development, production, installation and servicing

1 Scope

This International Standard specifies quality system requirements for use where a supplier's capability to design and supply conforming product needs to be demonstrated.

The requirements specified are aimed primarily at achieving customer satisfaction by preventing nonconformity at all stages from design through to servicing.

This International Standard is applicable in situations when

a) design is required and the product requirements are stated principally in performance terms, or they need to be established, and

b) confidence in product conformance can be attained by adequate demonstration of a supplier's capabilities in design, development, production, installation and servicing.

NOTE 1 For informative references, see annex A.

2 Normative reference

The following standard contains provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the edition indicated was valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent edition of the standard indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 8402:1994, *Quality management and quality assurance — Vocabulary.*

3 Definitions

For the purposes of this International Standard, the definitions given in ISO 8402 and the following definitions apply.

3.1 product: Result of activities or processes.

NOTES

2 A product may include service, hardware, processed materials, software or a combination thereof.

3 A product can be tangible (e.g. assemblies or processed materials) or intangible (e.g. knowledge or concepts), or a combination thereof.

4 For the purposes of this International Standard, the term "product" applies to the intended product offering only and not to unintended "by-products" affecting the environment. This differs from the definition given in ISO 8402.

3.2 tender: Offer made by a supplier in response to an invitation to satisfy a contract award to provide product.

3.3 contract: Agreed requirements between a supplier and customer transmitted by any means.

4 Quality system requirements

4.1 Management responsibility

4.1.1 Quality policy

The supplier's management with executive responsibility shall define and document its policy for quality,

including objectives for quality and its commitment to quality. The quality policy shall be relevant to the supplier's organizational goals and the expectations and needs of its customers. The supplier shall ensure that this policy is understood, implemented and maintained at all levels of the organization.

4.1.2 Organization

4.1.2.1 Responsibility and authority

The responsibility, authority and the interrelation of personnel who manage, perform and verify work affecting quality shall be defined and documented, particularly for personnel who need the organizational freedom and authority to:

a) initiate action to prevent the occurrence of any nonconformities relating to the product, process and quality system;

b) identify and record any problems relating to the product, process and quality system;

c) initiate, recommend or provide solutions through designated channels;

d) verify the implementation of solutions;

e) control further processing, delivery or installation of nonconforming product until the deficiency or unsatisfactory condition has been corrected.

4.1.2.2 Resources

The supplier shall identify resource requirements and provide adequate resources, including the assignment of trained personnel (see 4.18), for management, performance of work and verification activities including internal quality audits.

4.1.2.3 Management representative

The supplier's management with executive responsibility shall appoint a member of the supplier's own management who, irrespective of other responsibilities, shall have defined authority for

a) ensuring that a quality system is established, implemented and maintained in accordance with this International Standard, and

b) reporting on the performance of the quality system to the supplier's management for review and as a basis for improvement of the quality system.

NOTE 5 The responsibility of a management representative may also include liaison with external parties on matters relating to the supplier's quality system.

4.1.3 Management review

The supplier's management with executive responsibility shall review the quality system at defined intervals sufficient to ensure its continuing suitability and effectiveness in satisfying the requirements of this International Standard and the supplier's stated quality policy and objectives (see 4.1.1). Records of such reviews shall be maintained (see 4.16).

4.2 Quality system

4.2.1 General

The supplier shall establish, document and maintain a quality system as a means of ensuring that product conforms to specified requirements. The supplier shall prepare a quality manual covering the requirements of this International Standard. The quality manual shall include or make reference to the quality system procedures and outline the structure of the documentation used in the quality system.

NOTE 6 Guidance on quality manuals is given in ISO 10013.

4.2.2 Quality system procedures

The supplier shall

a) prepare documented procedures consistent with the requirements of this International Standard and the supplier's stated quality policy, and

b) effectively implement the quality system and its documented procedures.

For the purposes of this International Standard, the range and detail of the procedures that form part of the quality system shall be dependent upon the complexity of the work, the methods used, and the skills and training needed by personnel involved in carrying out the activity.

NOTE 7 Documented procedures may make reference to work instructions that define how an activity is performed.

4.2.3 Quality planning

The supplier shall define and document how the requirements for quality will be met. Quality planning shall be consistent with all other requirements of a supplier's quality system and shall be documented in a format to suit the supplier's method of operation.

The supplier shall give consideration to the following activities, as appropriate, in meeting the specified requirements for products, projects or contracts:

a) the preparation of quality plans;

b) the identification and acquisition of any controls, processes, equipment (including inspection and test equipment), fixtures, resources and skills that may be needed to achieve the required quality;

c) ensuring the compatibility of the design, the production process, installation, servicing, inspection and test procedures and the applicable documentation;

d) the updating, as necessary, of quality control, inspection and testing techniques, including the development of new instrumentation;

e) the identification of any measurement requirement involving capability that exceeds the known state of the art, in sufficient time for the needed capability to be developed;

f) the identification of suitable verification at appropriate stages in the realization of product;

g) the clarification of standards of acceptability for all features and requirements, including those which contain a subjective element;

h) the identification and preparation of quality records (see 4.16).

NOTE 8 The quality plans referred to [see 4.2.3 a)] may be in the form of a reference to the appropriate documented procedures that form an integral part of the supplier's quality system.

4.3 Contract review

4.3.1 General

The supplier shall establish and maintain documented procedures for contract review and for the coordination of these activities.

4.3.2 Review

Before submission of a tender, or the acceptance of a contract or order (statement of requirement), the tender, contract or order shall be reviewed by the supplier to ensure that:

a) the requirements are adequately defined and documented; where no written statement of requirement is available for an order received by verbal means, the supplier shall ensure that the order requirements are agreed before their acceptance;

b) any differences between the contract or order requirements and those in the tender are resolved;

c) the supplier has the capability to meet the contract or order requirements.

4.3.3 Amendment to a contract

The supplier shall identify how an amendment to a contract is made and correctly transferred to the functions concerned within the supplier's organization.

4.3.4 Records

Records of contract reviews shall be maintained (see 4.16).

NOTE 9 Channels for communication and interfaces with the customer's organization in these contract matters should be established.

4.4 Design control

4.4.1 General

The supplier shall establish and maintain documented procedures to control and verify the design of the product in order to ensure that the specified requirements are met.

4.4.2 Design and development planning

The supplier shall prepare plans for each design and development activity. The plans shall describe or reference these activities, and define responsibility for their implementation. The design and development activities shall be assigned to qualified personnel equipped with adequate resources. The plans shall be updated as the design evolves.

4.4.3 Organizational and technical interfaces

Organizational and technical interfaces between different groups which input into the design process shall be defined and the necessary information documented, transmitted and regularly reviewed.

4.4.4 Design input

Design input requirements relating to the product, including applicable statutory and regulatory requirements, shall be identified, documented and their selection reviewed by the supplier for adequacy. In-

complete, ambiguous or conflicting requirements shall be resolved with those responsible for imposing these requirements.

Design input shall take into consideration the results of any contract review activities.

4.4.5 Design output

Design output shall be documented and expressed in terms that can be verified and validated against design input requirements.

Design output shall:

a) meet the design input requirements;

b) contain or make reference to acceptance criteria;

c) identify those characteristics of the design that are crucial to the safe and proper functioning of the product (e.g. operating, storage, handling, maintenance and disposal requirements).

Design output documents shall be reviewed before release.

4.4.6 Design review

At appropriate stages of design, formal documented reviews of the design results shall be planned and conducted. Participants at each design review shall include representatives of all functions concerned with the design stage being reviewed, as well as other specialist personnel, as required. Records of such reviews shall be maintained (see 4.16).

4.4.7 Design verification

At appropriate stages of design, design verification shall be performed to ensure that the design stage output meets the design stage input requirements. The design verification measures shall be recorded (see 4.16).

NOTE 10 In addition to conducting design reviews (see 4.4.6), design verification may include activities such as

— performing alternative calculations,

— comparing the new design with a similar proven design, if available,

— undertaking tests and demonstrations, and

— reviewing the design stage documents before release.

4.4.8 Design validation

Design validation shall be performed to ensure that product conforms to defined user needs and/or requirements.

NOTES

11 Design validation follows successful design verification (see 4.4.7).

12 Validation is normally performed under defined operating conditions.

13 Validation is normally performed on the final product, but may be necessary in earlier stages prior to product completion.

14 Multiple validations may be performed if there are different intended uses.

4.4.9 Design changes

All design changes and modifications shall be identified, documented, reviewed and approved by authorized personnel before their implementation.

4.5 Document and data control

4.5.1 General

The supplier shall establish and maintain documented procedures to control all documents and data that relate to the requirements of this International Standard including, to the extent applicable, documents of external origin such as standards and customer drawings.

NOTE 15 Documents and data can be in the form of any type of media, such as hard copy or electronic media.

4.5.2 Document and data approval and issue

The documents and data shall be reviewed and approved for adequacy by authorized personnel prior to issue. A master list or equivalent document control procedure identifying the current revision status of documents shall be established and be readily available to preclude the use of invalid and/or obsolete documents.

This control shall ensure that:

a) the pertinent issues of appropriate documents are available at all locations where operations essential to the effective functioning of the quality system are performed;

b) invalid and/or obsolete documents are promptly removed from all points of issue or use, or otherwise assured against unintended use;

c) any obsolete documents retained for legal and/or knowledge-preservation purposes are suitably identified.

4.5.3 Document and data changes

Changes to documents and data shall be reviewed and approved by the same functions/organizations that performed the original review and approval, unless specifically designated otherwise. The designated functions/organizations shall have access to pertinent background information upon which to base their review and approval.

Where practicable, the nature of the change shall be identified in the document or the appropriate attachments.

4.6 Purchasing

4.6.1 General

The supplier shall establish and maintain documented procedures to ensure that purchased product (see 3.1) conforms to specified requirements.

4.6.2 Evaluation of subcontractors

The supplier shall:

a) evaluate and select subcontractors on the basis of their ability to meet subcontract requirements including the quality system and any specific quality assurance requirements;

b) define the type and extent of control exercised by the supplier over subcontractors. This shall be dependent upon the type of product, the impact of subcontracted product on the quality of final product and, where applicable, on the quality audit reports and/or quality records of the previously demonstrated capability and performance of subcontractors;

c) establish and maintain quality records of acceptable subcontractors (see 4.16).

4.6.3 Purchasing data

Purchasing documents shall contain data clearly describing the product ordered, including where applicable:

a) the type, class, grade or other precise identification;

b) the title or other positive identification, and applicable issues of specifications, drawings, process requirements, inspection instructions and other relevant technical data, including requirements for approval or qualification of product, procedures, process equipment and personnel;

c) the title, number and issue of the quality system standard to be applied.

The supplier shall review and approve purchasing documents for adequacy of the specified requirements prior to release.

4.6.4 Verification of purchased product

4.6.4.1 Supplier verification at subcontractor's premises

Where the supplier proposes to verify purchased product at the subcontractor's premises, the supplier shall specify verification arrangements and the method of product release in the purchasing documents.

4.6.4.2 Customer verification of subcontracted product

Where specified in the contract, the supplier's customer or the customer's representative shall be afforded the right to verify at the subcontractor's premises and the supplier's premises that subcontracted product conforms to specified requirements. Such verification shall not be used by the supplier as evidence of effective control of quality by the subcontractor.

Verification by the customer shall not absolve the supplier of the responsibility to provide acceptable product, nor shall it preclude subsequent rejection by the customer.

4.7 Control of customer-supplied product

The supplier shall establish and maintain documented procedures for the control of verification, storage and maintenance of customer-supplied product provided for incorporation into the supplies or for related activities. Any such product that is lost, damaged or is otherwise unsuitable for use shall be recorded and reported to the customer (see 4.16).

Verification by the supplier does not absolve the customer of the responsibility to provide acceptable product.

4.8 Product identification and traceability

Where appropriate, the supplier shall establish and maintain documented procedures for identifying the product by suitable means from receipt and during all stages of production, delivery and installation.

Where and to the extent that traceability is a specified requirement, the supplier shall establish and maintain documented procedures for unique identification of individual product or batches. This identification shall be recorded (see 4.16).

4.9 Process control

The supplier shall identify and plan the production, installation and servicing processes which directly affect quality and shall ensure that these processes are carried out under controlled conditions. Controlled conditions shall include the following:

a) documented procedures defining the manner of production, installation and servicing, where the absence of such procedures could adversely affect quality;

b) use of suitable production, installation and servicing equipment, and a suitable working environment;

c) compliance with reference standards/codes, quality plans and/or documented procedures;

d) monitoring and control of suitable process parameters and product characteristics;

e) the approval of processes and equipment, as appropriate;

f) criteria for workmanship, which shall be stipulated in the clearest practical manner (e.g. written standards, representative samples or illustrations);

g) suitable maintenance of equipment to ensure continuing process capability.

Where the results of processes cannot be fully verified by subsequent inspection and testing of the product and where, for example, processing deficiencies may become apparent only after the product is in use, the processes shall be carried out by qualified operators and/or shall require continuous monitoring and control of process parameters to ensure that the specified requirements are met.

The requirements for any qualification of process operations, including associated equipment and personnel (see 4.18), shall be specified.

NOTE 16 Such processes requiring pre-qualification of their process capability are frequently referred to as special processes.

Records shall be maintained for qualified processes, equipment and personnel, as appropriate (see 4.16).

4.10 Inspection and testing

4.10.1 General

The supplier shall establish and maintain documented procedures for inspection and testing activities in order to verify that the specified requirements for the product are met. The required inspection and testing, and the records to be established, shall be detailed in the quality plan or documented procedures.

4.10.2 Receiving inspection and testing

4.10.2.1 The supplier shall ensure that incoming product is not used or processed (except in the circumstances described in 4.10.2.3) until it has been inspected or otherwise verified as conforming to specified requirements. Verification of conformance to the specified requirements shall be in accordance with the quality plan and/or documented procedures.

4.10.2.2 In determining the amount and nature of receiving inspection, consideration shall be given to the amount of control exercised at the subcontractor's premises and the recorded evidence of conformance provided.

4.10.2.3 Where incoming product is released for urgent production purposes prior to verification, it shall be positively identified and recorded (see 4.16) in order to permit immediate recall and replacement in the event of nonconformity to specified requirements.

4.10.3 In-process inspection and testing

The supplier shall:

a) inspect and test the product as required by the quality plan and/or documented procedures;

b) hold product until the required inspection and tests have been completed or necessary reports have been received and verified, except when product is released under positive-recall procedures (see 4.10.2.3). Release under positive-recall procedures shall not preclude the activities outlined in 4.10.3 a).

4.10.4 Final inspection and testing

The supplier shall carry out all final inspection and testing in accordance with the quality plan and/or documented procedures to complete the evidence of conformance of the finished product to the specified requirements.

The quality plan and/or documented procedures for final inspection and testing shall require that all specified inspection and tests, including those specified either on receipt of product or in-process, have been carried out and that the results meet specified requirements.

No product shall be dispatched until all the activities specified in the quality plan and/or documented procedures have been satisfactorily completed and the associated data and documentation are available and authorized.

4.10.5 Inspection and test records

The supplier shall establish and maintain records which provide evidence that the product has been inspected and/or tested. These records shall show clearly whether the product has passed or failed the inspections and/or tests according to defined acceptance criteria. Where the product fails to pass any inspection and/or test, the procedures for control of nonconforming product shall apply (see 4.13).

Records shall identify the inspection authority responsible for the release of product (see 4.16).

4.11 Control of inspection, measuring and test equipment

4.11.1 General

The supplier shall establish and maintain documented procedures to control, calibrate and maintain inspection, measuring and test equipment (including test software) used by the supplier to demonstrate the conformance of product to the specified requirements. Inspection, measuring and test equipment shall be used in a manner which ensures that the measurement uncertainty is known and is consistent with the required measurement capability.

Where test software or comparative references such as test hardware are used as suitable forms of inspection, they shall be checked to prove that they are capable of verifying the acceptability of product, prior to release for use during production, installation or servicing, and shall be rechecked at prescribed intervals. The supplier shall establish the extent and frequency of such checks and shall maintain records as evidence of control (see 4.16).

Where the availability of technical data pertaining to the inspection, measuring and test equipment is a specified requirement, such data shall be made available, when required by the customer or customer's representative, for verification that the inspection, measuring and test equipment is functionally adequate.

NOTE 17 For the purposes of this International Standard, the term "measuring equipment" includes measurement devices.

4.11.2 Control procedure

The supplier shall:

a) determine the measurements to be made and the accuracy required, and select the appropriate inspection, measuring and test equipment that is capable of the necessary accuracy and precision;

b) identify all inspection, measuring and test equipment that can affect product quality, and calibrate and adjust them at prescribed intervals, or prior to use, against certified equipment having a known valid relationship to internationally or nationally recognized standards. Where no such standards exist, the basis used for calibration shall be documented;

c) define the process employed for the calibration of inspection, measuring and test equipment, including details of equipment type, unique identification, location, frequency of checks, check method, acceptance criteria and the action to be taken when results are unsatisfactory;

d) identify inspection, measuring and test equipment with a suitable indicator or approved identification record to show the calibration status;

e) maintain calibration records for inspection, measuring and test equipment (see 4.16);

f) assess and document the validity of previous inspection and test results when inspection, measuring or test equipment is found to be out of calibration;

g) ensure that the environmental conditions are suitable for the calibrations, inspections, measurements and tests being carried out;

h) ensure that the handling, preservation and storage of inspection, measuring and test equipment is

such that the accuracy and fitness for use are maintained;

i) safeguard inspection, measuring and test facilities, including both test hardware and test software, from adjustments which would invalidate the calibration setting.

NOTE 18 The metrological confirmation system for measuring equipment given in ISO 10012 may be used for guidance.

4.12 Inspection and test status

The inspection and test status of product shall be identified by suitable means, which indicate the conformance or nonconformance of product with regard to inspection and tests performed. The identification of inspection and test status shall be maintained, as defined in the quality plan and/or documented procedures, throughout production, installation and servicing of the product to ensure that only product that has passed the required inspections and tests [or released under an authorized concession (see 4.13.2)] is dispatched, used or installed.

4.13 Control of nonconforming product

4.13.1 General

The supplier shall establish and maintain documented procedures to ensure that product that does not conform to specified requirements is prevented from unintended use or installation. This control shall provide for identification, documentation, evaluation, segregation (when practical), disposition of nonconforming product, and for notification to the functions concerned.

4.13.2 Review and disposition of nonconforming product

The responsibility for review and authority for the disposition of nonconforming product shall be defined.

Nonconforming product shall be reviewed in accordance with documented procedures. It may be

a) reworked to meet the specified requirements,

b) accepted with or without repair by concession,

c) regraded for alternative applications, or

d) rejected or scrapped.

Where required by the contract, the proposed use or repair of product (see 4.13.2 b)) which does not conform to specified requirements shall be reported for concession to the customer or customer's representative. The description of the nonconformity that has been accepted, and of repairs, shall be recorded to denote the actual condition (see 4.16).

Repaired and/or reworked product shall be re-inspected in accordance with the quality plan and/or documented procedures.

4.14 Corrective and preventive action

4.14.1 General

The supplier shall establish and maintain documented procedures for implementing corrective and preventive action.

Any corrective or preventive action taken to eliminate the causes of actual or potential nonconformities shall be to a degree appropriate to the magnitude of problems and commensurate with the risks encountered.

The supplier shall implement and record any changes to the documented procedures resulting from corrective and preventive action.

4.14.2 Corrective action

The procedures for corrective action shall include

a) the effective handling of customer complaints and reports of product nonconformities;

b) investigation of the cause of nonconformities relating to product, process and quality system, and recording the results of the investigation (see 4.16);

c) determination of the corrective action needed to eliminate the cause of nonconformities;

d) application of controls to ensure that corrective action is taken and that it is effective.

4.14.3 Preventive action

The procedures for preventive action shall include:

a) the use of appropriate sources of information such as processes and work operations which affect product quality, concessions, audit results, quality records, service reports and customer complaints to detect, analyse and eliminate potential causes of nonconformities;

b) determination of the steps needed to deal with any problems requiring preventive action;

c) initiation of preventive action and application of controls to ensure that it is effective;

d) ensuring that relevant information on actions taken is submitted for management review (see 4.1.3).

4.15 Handling, storage, packaging, preservation and delivery

4.15.1 General

The supplier shall establish and maintain documented procedures for handling, storage, packaging, preservation and delivery of product.

4.15.2 Handling

The supplier shall provide methods of handling product that prevent damage or deterioration.

4.15.3 Storage

The supplier shall use designated storage areas or stock rooms to prevent damage or deterioration of product pending use or delivery. Appropriate methods for authorizing receipt to and dispatch from such areas shall be stipulated.

In order to detect deterioration, the condition of product in stock shall be assessed at adequate intervals.

4.15.4 Packaging

The supplier shall control packing, packaging and marking processes (including materials used) to the extent necessary to ensure conformance to specified requirements.

4.15.5 Preservation

The supplier shall apply appropriate methods for preservation and segregation of product when the product is under the supplier's control.

4.15.6 Delivery

The supplier shall arrange for the protection of the quality of product after final inspection and test. Where contractually specified, this protection shall be extended to include delivery to destination.

4.16 Control of quality records

The supplier shall establish and maintain documented procedures for identification, collection, indexing, access, filing, storage, maintenance and disposition of quality records.

Quality records shall be maintained to demonstrate conformance to specified requirements and the effective operation of the quality system. Pertinent quality records from the subcontractor shall be an element of these data.

All quality records shall be legible and shall be stored and retrieved in such a way that they are readily retrievable in facilities that provide a suitable environment to prevent damage or deterioration and to prevent loss. Retention times of quality records shall be established and recorded. Where agreed contractually, quality records shall be made available for evaluation by the customer or the customer's representative for an agreed period.

NOTE 19 Records may be in the form of any type of media, such as hard copy or electronic media.

4.17 Internal quality audits

The supplier shall establish and maintain documented procedures for planning and implementing internal audits to verify whether quality activities and related results comply with planned arrangements and to determine the effectiveness of the quality system.

Internal quality audits shall be scheduled on the basis of the status and importance of the activity to be audited and shall be carried out by personnel independent of those having direct responsibility for the activity being audited.

The results of the audits shall be recorded (see 4.16) and brought to the attention of the personnel having responsibility in the area audited. The management personnel responsible for the area shall take timely corrective action on deficiencies found during the audit.

Follow-up audit activities shall verify and record the implementation and effectiveness of the corrective action taken (see 4.16).

NOTES

20 The results of internal quality audits form an integral part of the input to management review activities (see 4.1.3).

21 Guidance on quality system audits is given in ISO 10011.

4.18 Training

The supplier shall establish and maintain documented procedures for identifying training needs and provide for the training of all personnel performing activities affecting quality. Personnel performing specific assigned tasks shall be qualified on the basis of appropriate education, training and/or experience, as required. Appropriate records of training shall be maintained (see 4.16).

4.19 Servicing

Where servicing is a specified requirement, the supplier shall establish and maintain documented procedures for performing, verifying and reporting that the servicing meets the specified requirements.

4.20 Statistical techniques

4.20.1 Identification of need

The supplier shall identify the need for statistical techniques required for establishing, controlling and verifying process capability and product characteristics.

4.20.2 Procedures

The supplier shall establish and maintain documented procedures to implement and control the application of the statistical techniques identified in 4.20.1

APPENDIX C. SAMPLE QUALITY MANUAL FOR THE TOOL CONTROL PROGRAM. FROM REF. [12].

Any AIMD	Section 0.1	Page 1 of 1
Quality System Manual		

0.1 TABLE OF CONTENTS

1.0 RECORD OF CHANGES

This manual establishes the Quality System for the control of tools used for maintenance within the AIMD. Changes may be requested by any division of the AIMD, but will be incorporated in the manual by the Quality Assurance Division if approved by the Commanding Officer. A transmittal letter will describe approved changes. As a minimum, the manual will be reviewed annually by the Quality Assurance Division, and will be updated accordingly.

CHANGE NUMBER	DATE OF CHANGE	CHANGE MADE DATE	INITIALS	CHANGE NUMBER	DATE OF CHANGE	CHANGE MADE DATE	INITIALS

2.0 INTRODUCTION. The Quality System at this AIMD is designed to ensure adequate controls and documentation throughout all areas of performance, and to ensure compliance with all requirements. It encourages maximum weapon system availability at minimum cost without compromise to quality. This Quality System reflects documented procedures required by the International Organization for Standardization (ISO) 9000.

2.1 Scope. All divisions are responsible to ensure that quality issues are afforded adequate attention during the accomplishment of functional responsibilities. This Quality System is applicable command wide and involves all activities that are directly or indirectly involved in the Tool Control Program. Functional responsibilities are identified in AIMD instructions and standard operating procedures. When implementing Quality System requirements the latest revision of referenced instructions/procedures apply. The system described in this Command's ISO Quality Manual complies with the requirements of the ISO 9000 Standard.

2.2 Quality manual. The Quality Assurance (QA) Division is responsible for preparation and revision of the command ISO Quality Manual. Recommended revisions to this manual may be submitted by any division of the AIMD, but shall be approved by the Commanding Officer prior to incorporation in this manual. Organizations within the AIMD may develop and maintain their own ISO quality manual as long as those manuals meet the requirements of this command ISO Quality Manual. This command ISO Quality Manual will establish AIMD-wide Quality System requirements, and will therefore not include or make reference to individual organizational quality manuals.

The command ISO Quality Manual will be reviewed annually and will be revised and updated accordingly.

2.3 Distribution and control. The Directives Control Office will maintain the command ISO Quality Manual (Master Copy) and will distribute the controlled copy of the manual. They will maintain a complete copy of each command ISO Quality Manual revision on file beginning with this original issue.

The command's ISO Quality Manual will require a revision change whenever there is a change, addition or deletion to the text. Typographical corrections, grammar corrections, or minor changes for clarity (providing the intent is not altered) do not constitute a revision change.

The letter following the superseded revision will designate each revision. Subsequent revisions will continue alphabetically.

Paragraphs revised will be noted by a vertical line drawn in the left margins unless the change is significant enough to warrant a complete rewrite. A transmittal letter signed by the Commanding Officer will provide a description of each specific revision change. The QA Division will incorporate the change(s) and the transmittal letter in the controlled copy. The Record of Changes will reflect the change number, date of change, date the change is incorporated and the initials of the individual incorporating the change. The transmittal letter will be incorporated directly following the Record of Changes page.

Two types of command ISO Quality Manuals will be distributed:

a. Controlled. The controlled command ISO Quality Manual will be updated with the latest revision will be serialized and distributed to each work center. Each individual photocopying the manual will be responsible for identifying the copy "For Knowledge or Preservation Purposes" and for the destruction of superseded copies.

b. Uncontrolled. Uncontrolled command ISO Quality Manuals will be effective at time of distribution, but will not be updated with later revisions. Uncontrolled copies will be marked "For Knowledge or Preservation Purposes", and will require the user to verify the latest revision prior to use.

3.0 QUALITY POLICY STATEMENT

4855
Ser 6.4.1-JE

MEMORANDUM FOR ALL HANDS

Subj: AIMD'S QUALITY POLICY STATEMENT

Ref: International Standard ISO 9001 Second edition 1994-07-01 paragraph 4.1.1

1. In complying with the reference, I personally commit to the following Quality Policy:

AIMD QUALITY POLICY

ENHANCE AND SUSTAIN THE COMBAT READINESS AND MISSION CAPABILITY OF SUPPORTED ACTIVITIES BY PROVIDING QUALITY AND TIMELY MATERIAL SUPPORT AT THE NEAREST LOCATION WITH THE LOWEST PRACTICAL RESOURCE EXPENDITURE

2. With this policy, we are committing to pursuing our customer's expectations and satisfaction through continuous improvement of our processes. The AIMD's objective is to perform all activities with dedication to quality. AIMD wide quality, as our objective, means attaining a level of overall performance and attitude and earns the respect of all those affected by the AIMD's activities.

4. I lead the AIMD's effort to establish a quality program to meet the quality system standard ISO 9000, and expect all personnel of the AIMD to join me in the endeavor to comply with the spirit and intent of our Quality Policy.

4.0 QUALITY SYSTEM REQUIREMENTS

4.1 MANAGEMENT RESPONSIBILITY

4.1.1 Quality Policy. We will enhance and sustain the combat readiness and mission capability of supported activities by providing quality and timely material support at the nearest location with the lowest practical resource expenditure. This policy will be transmitted and explained to all personnel at all levels of the command.

4.1.2 Organization

4.1.2.1 Responsibility and authority. Requirements and responsibilities are established throughout this manual and other related AIMD instructions to provide a check and balance system for ensuring compliance to quality requirements. General duties and responsibilities for all personnel are as defined in OPNAVINST 4790.2, Naval Aviation Maintenance Program. Individual job and position descriptions reflect the scope of employee control. The responsibility, authority and interrelation of personnel who manage, perform and verify work affecting quality is defined and documented providing organizational freedom and authority for identifying, recording, and fixing problems relating to products, processes and our quality system.

All personnel have the authority and responsibility to identify problems relating to products, processes, and the quality system, and to notify appropriate personnel when a deficiency or nonconformance is detected. All personnel, also, have the authority and responsibility to initiate action to prevent the occurrence of nonconformances, and for identifying corrective and preventive solutions through designated levels of management. Management has the responsibility to verify the implementation of solutions, or to delegate responsibility to subordinates to ensure root cause of nonconformances is identified and corrected. The ultimate responsibility remains with management to ensure root cause is identified and corrected to control further processing, delivery or installation of non-conforming products until the deficiency or unsatisfactory condition has been corrected.

4.1.2.2 Resources. The AIMD Officer or their designated representative is responsible for providing adequate resources and assigning trained qualified personnel (see 4.18) for managing, performing and verifying all tool control related activities including internal quality audits.

4.1.2.3 Management representative. The AIMD Officer will appoint and assign in writing the Management Representative. The Management Representative will have sufficient authority to ensure the quality system is established and maintained in accordance with the ISO 9000 standard. The Management Representative will report on the performance of the quality system to the AIMD Officer, and will act as a liaison with the ISO 9000 Registrar. In the absence of the Management Representative, a qualified alternate will be appointed. The AIMD Management Representative will have the responsibility for reporting on the overall performance of the quality system to the AIMD Officer.

4.1.3 Management review. The QA Division and the Management Representative will review bi-annually the quality system. The purpose of the reviews will be to assess the effectiveness and continuing suitability of the quality system in satisfying the requirements of the ISO and the AIMD's stated policy (see 4.1.1). Results of the reviews will be used to improve operational effectiveness and efficiency, to agree upon corrective actions, and to review effectiveness of previous corrective actions. Additional meetings will be held as necessary.

Minutes of the quality system review will be maintained by the AIMD Officer's administration aide (see 4.16) and distributed to persons responsible for effective implementation of the quality system.

4.1.4 Related documentation. Detailed approved methods are provided in:

OPNAVINST 4790.2
ISO 9001

4.2 QUALITY SYSTEM

4.2.1 General. This Quality Manual describes the system for establishing, documenting and maintaining a quality system as a means of ensuring that product conforms to specified requirements. It conveys system requirements to personnel and includes or makes reference to quality system procedures and documentation.

All Work Center Supervisors are responsible for implementation and compliance to Quality System requirements. All personnel are responsible for adherence to the stated quality policy and to quality system requirements.

4.2.2 Quality system procedures. Procedures shall define and document how the requirements of the ISO 9002, the quality system, and the stated quality policy shall be met.
The range and detail of procedures shall be dependent upon the complexity of the operation, and will define the methods used for achievement of the established goals and the skills and training needed by personnel performing the function. Tiers of the quality system include this manual (level I), Naval Aviation AIMD Instructions (level II), work instructions and standard operating procedures (level III), and records, reports and forms (level IV). ISO Quality Manuals developed by the various focus groups may be a level I document for a specific focus group but shall not conflict with or supersede the requirements of this manual or the requirements of level II AIMD instructions.

AIMD instructions impacting the Quality Program shall be made available to the Quality organization for review prior to publication. Quality system procedures shall be readily available for ensuring compliance to quality requirements. All personnel shall be responsible for compliance to applicable quality system procedures.

4.2.3 Quality planning. All Work Center Supervisors shall ensure work performed is effectively planned. Quality planning shall be accomplished consistent with all other requirements of the AIMD quality system. The planning process shall be documented in a format suitable to standard methods of operation. Consideration shall be given to the following activities for meeting the specified requirements for products produced and processes performed:

- preparation of quality plans;

- identification and acquisition of controls, processes, equipment (including inspection and test equipment), fixtures, resources and skills that may be needed to achieve the required quality;

- compatibility of design, production process, installation, servicing, inspection and test procedures and applicable documentation;

- updating of any inspection and testing techniques as required (including development of new equipment or instrumentation);

- identification of any measurement requirements which involve capabilities that exceed the known state of the art in sufficient time for the needed capability to be developed;

- identification of suitable certification and verification requirements at appropriate stages in our processes;

- clarification of all standards of acceptability for features and requirements (including any subjective elements)

- identification and preparation of quality records (see 4.16).

4.2.4 Related documentation. The documented quality system is made up of the quality manual, other AIMD instructions, operational procedures, and work instructions, specific instruction manuals and other documentation. Detailed approved methods are provided in the latest revisions of:

OPNAVINST 4790.2

4.3 CONTRACT REVIEW

4.4.1 General. Documented procedures shall be established and maintained for customer contract review and for coordination of these activities. Contracts for supplies and services are covered under Section 4.6.

4.4.2 Review. At the earliest practical phase of a contract or agreement, or subsequent to the acceptance of a newly assigned aeronautical component, equipment, or weapons systems, a review shall be conducted to make timely provisions for ensuring product quality. The review will include the availability of AIMD resources and the capability to meet customer requirements.

The AIMD will ensure requirements are adequately defined, documented, and agreed upon prior to acceptance; differences are resolved; and AIMD capability has been established to meet the requirements.

4.4.3 Amendment to a contract. The AIMD will identify how an amendment to a customer contract is made and transferred to the concerned functions within the AIMD. Changes to the original requirements, or additional requirements will be reviewed and agreed upon by this same organization.

4.4.4 Records. Records will be established and maintained of new or potentially new workload and for initiating required internal actions (see 4.16).

4.4.5 Related documentation. Detailed approved methods are provided in the latest revision of:

OPNAVINST 4790.2

4.4 DESIGN CONTROL

4.4.1 General. The Commanding Officer will establish policy concerning design at a time when product design is accomplished by this AIMD. There are no quality activities at this time since the AIMD does not provide significant design of products as a part of its mission.

4.4.2 Related documentation. None at this time.

4.5 DOCUMENT AND DATA CONTROL

4.5.1 General. This Quality Manual, other AIMD instructions, procedures, and work instructions document the Quality System. Control will include issue, approval, review, distribution, modification, and deletion or removal of obsolete documents. Documents can be found in the form of hard copy and electronic media.

4.5.2 Document and data approval and issue. Quality system documents and AIMD instructions including the Quality Manual are reviewed and approved prior to issue. Cognizant AIMD organizations perform the review of instructions with approval signature by the Commanding Officer. All departments review, approve and issue other documents directly as they pertain. Quality documentation will be available at each location where needed. Obsolete or invalid documents retained for legal or knowledge preservation purposes will be suitably identified.

4.5.3 Document and data changes. Authorized personnel, before issue, will review quality documentation changes and modifications, preferably by the same functional organization that initially approved the documentation. A master list of AIMD instructions and a master list of drawings and technical specifications will be established and maintained. All divisions are responsible for maintaining a master list of documents and pertinent background information pertaining specifically to their area upon which to base their review and approval.

4.5.4 Related documentation. Detailed approved methods are provided in the latest revisions of:

OPNAVINST 4790.2

4.6 PURCHASING

4.6.1 General. The AIMD is required to use pre-existing laws, documented government methods, procedures, and agencies for the procurement of all supplies and services. Procedures will be established and maintained to ensure purchased product conforms to specified requirements when pre-existing government procedures need amplification or clarification for AIMD implementation.

4.6.2 Evaluation of subcontractors. Subcontractors will be evaluated and selected based upon their capability to meet requirements of the defense and federal acquisition regulations. The type of product, the impact on the end product, and previously demonstrated capability and performance will determine control. Agencies having cognizance over the supply or service will perform the evaluation, make the selection, and maintain the quality records (see 4.16).

4.6.3 Purchasing data. Purchasing documents will clearly identify the item to be procured and the quantity required to a level of detail that assures delivery of the item required to perform its intended use. Purchasing control will provide the complete technical detail including the inspection instructions and quality system standard, where applicable.

The AIMD will ensure purchase documents are prepared to satisfy requirements, and that purchase documents/requisitions are reviewed and approved for adequacy. Receipt inspection of materials will be performed in accordance with established procedures. Unsatisfactory material, when received, will be dispositioned using approved methods to prevent inadvertent use. Purchasing and material acceptance documentation will be retained as specified in established procedures.

4.6.4 Verification of purchased product.

4.6.4.1 Supplier verification at subcontractor's premises. Verification arrangements and method of product release will be specified on purchase documents when material is to be verified at the subcontractor's premises.

4.6.4.2 Customer verification of subcontracted product. Customer verification of subcontractors will be in accordance with federal guidelines. Verification by the customer shall not absolve the AIMD of the responsibility to provide an acceptable product, nor will it prevent the rejection of products by the customer. Subcontractors shall not use customer verification as evidence of effective control of quality.

4.6.5 Related documentation. Detailed approved methods are provided in the latest revisions of:

Federal Acquisition Regulations
Defense Acquisition Regulations
OPNAVINST 4790.2

4.7 CONTROL OF CUSTOMER-SUPPLIED PRODUCT. Customer supplied products will be controlled in the same manner and by the same procedures as other products purchased for incorporation into supplies or for related activities. When specified in a contract or agreement, special handling instructions from customers will take precedent over standard procedures. Loss, damage, or unsuitability will be recorded and reported to the customer (see 4.16).

Customer supplied products are received, inspected, and tested in the same manner as other purchased products. Marking, storage, handling, and preservation of customer supplied products also follow the same procedures that apply generally to purchased products. Verification by the AIMD does not absolve the customer of the responsibility to provide an acceptable product.

4.7.1 Related documentation. Detailed approved methods are provided in the latest revisions of:

OPNAVINST 4790.2

4.8 PRODUCT IDENTIFICATION AND TRACEABILITY. Where appropriate, the AIMD will establish and maintain procedures for identifying products from receipt and during all stages of production, delivery and installation. A part number corresponding to drawings, specifications, and other technical documents will identify all products. Unique identification is applied when traceability beyond the part number is necessary (see 4.16).

The Tool Control Program Coordinator is responsible for ensuring tools are properly identified during receipt and storage. Material Control is responsible for identification of products that are being routed. The Production Control is responsible for maintaining proper identification of products during the production process. All personnel using certification and verification stamps are responsible for proper use and application of their stamp.

4.8.1 Related documentation. Detailed approved methods are provided in the latest revisions of:

OPNAVINST 4790.2

4.9 PROCESS CONTROL. All processes that directly affect quality will be performed under controlled conditions. Documented procedures or specifications defining the techniques to be applied will be developed and approved prior to use. Process procedures and specifications will be written in a manner that can be easily understood by those performing the work. Processes will be performed in the proper working environment using suitable equipment.

Appropriate documented work documents will be used and will reference applicable technical requirements. As appropriate, processes and equipment will be approved and maintained to ensure continuing processing capability.

Personnel will be qualified to perform the functions assigned, and will comply with documented procedures, quality plans, and reference standards. Properly trained and qualified personnel (see 4.18) using calibrated and properly maintained equipment will perform production processes. Processes will be monitored to ensure that parameters, requirements, specifications and instructions are being complied with. Special process certification will be required on designated processes that are not readily verifiable. Appropriate records will be maintained for qualified processes, equipment and personnel.

Serialized certification stamps will be used on work documents and/or ready for issue tags that attests to the inspection and test status, and documents that all product and quality characteristics conform to specifications and requirements. Verification stamps signify that those characteristics verified have been judged to be in conformance with appropriate specifications and requirements. Certification and verification stamp designs are unique to the particular purpose, with each stamp traceable to the individual responsible for its use.

4.9.1 Related documentation. Detailed approved methods are provided in the latest revisions of:

OPNAVINST 4790.2

4.10 INSPECTION AND TESTING.

4.10.1 General. Documented procedures shall be established and maintained for inspection and testing activities in order to verify that specified requirements are met. Inspection and testing will be performed when products are received, at various stages of production, and prior to release of the finished product. Parts will not be released prior to completion of testing, inspections and required verifications. Specified records will be established and maintained.

4.10.2 Receiving inspection and testing.

4.10.2.1 Government agencies external to the AIMD share responsibility for ensuring inspection and testing of products from suppliers and subcontractors is performed prior to release. Verification of conformance will be in accordance with the applicable agencies' documented procedures. Inspection and acceptance documentation will remain with that agency unless otherwise specified.

4.10.2.2 Materials and products received that have not been previously inspected and tested by another government agency will be inspected to the extent necessary to ensure conformance to technical requirements. Inspection will be adjusted based on objective evidence of the supplier's control of quality. Nonconforming material and products will be segregated from use in production.

The raw materials used in fabrication or processing of products must conform to applicable physical, chemical, other technical requirements, and must be traceable back to point of origin. Adequate laboratory testing will be performed, and used in conjunction with supplier's material analysis certification to determine acceptability of material received.

4.10.2.3 Material waiting testing, or material released for urgent production purposes will be separately identified or segregated from already tested and approved material. Identification and control will be recorded (see 4.16) and maintained throughout the production process until assurance of conformity to specified requirements is obtained. **Inadvertent use of material failing to meet requirements will be unacceptable.**

4.10.3 In-process inspection and testing. The individuals qualified and certified to perform the tasks will perform in-process inspection and testing. Certification will document that all product and quality characteristics conform to applicable specifications

and requirements. Verification will be the method used for objective evaluation to determine and measure the effectiveness of the certifications. Appropriate verifications will be performed during the manufacture, rework, or repair cycle to prevent defects from occurring and for the purpose of verifying those product and quality characteristics that could be obscured by further processing. Required inspections, tests, and verifications will be completed and documented prior to moving to the next phase of production except when released under positive-recall procedures (see 4.10.2.3). Products will not be released to the customer prior to completion of all testing, inspections.

4.10.4 Final inspection and testing. Final inspections, tests, and verifications will be performed where prescribed in documented procedures. Certifications will be performed to document the actual final inspection and tests conform to requirements. Required verifications will be performed to provide the assurance that quality characteristics conform to requirements defining form, fit, and function. Products will not be released until all required certifications and verifications have been completed and documented indicating specified requirements have been met.

4.10.5 Inspection and test records. Records indicating required inspections, tests, and verifications have been performed will be established and maintained. Records will indicate if the product has passed or failed the inspections and/or tests according to acceptance criteria. Discrepancies and applicable corrective action will be documented in accordance with procedures for controlling nonconforming products (see 4.13). Records will indicate authority for release of the product (see 4.16).

4.10.6 Related documentation. Detailed approved methods are provided in the latest revisions of:

OPNAVINST 4790.2

4.11 CONTROL OF INSPECTION, MEASURING AND TEST EQUIPMENT

4.11.1 General. A comprehensive calibration program will be established and maintained to control, calibrate and maintain inspection, measuring and test equipment used in the AIMD and on equipment processed for our customers to demonstrate the conformance of product to the specified requirements. Use of inspection, measuring and test equipment shall be in a manner to ensure measurement uncertainty is known and consistent with required capability. Comparative references (e.g. production jigs, fixtures, templates, alignment kits, tooling masters, patterns) and test software used as a media of inspection will be proved for accuracy prior to release for use and at regularly scheduled intervals to ensure continued accuracy. Type and frequency of calibration will be established. Records reflecting calibration as evidence of control will be maintained (see 4.16). Technical data pertaining to inspection, measuring and test equipment is documented and will be made available to our customers when required for verification that equipment is functionally adequate.

4.11.2 Control procedure. The AIMD's metrology and calibration (METCAL) program is directed by the Naval Air Systems Command (NAVAIR). The METCAL program controls inspection, measuring, and test equipment complying with NAVAIR calibration instructions and specifications, and record keeping. Program requirements include:

- determining measurements, required accuracy, and selecting equipment capable of the necessary accuracy and precision;
- identification, calibration, and adjustment of inspection, measuring and test equipment at prescribed intervals, or prior to use, against certified equipment having a known relationship to recognized standards;
- defining the process used for calibration including equipment type, identification, location, frequency of checks, check method, acceptance criteria and the action to be taken when results are unsatisfactory;
- use of calibration decals to indicate status of calibration;
- maintaining calibration records for inspection, measuring and test equipment (see 4.16);

- assessing and documenting validity of previous inspection and test results when inspection, measuring or test equipment is found to be out of calibration;

- ensuring environmental conditions are suitable, and that program equipment is stored, handled, and preserved such that accuracy and fitness for use are maintained; and

- safeguarding test hardware and test software from adjustments which would invalidate the calibration setting.

4.11.3 Related documentation. Detailed approved methods are provided in the latest revisions of:

OPNAVINST 4790.2

4.12 INSPECTION AND TEST STATUS. Serialized certification stamps will be used on work documents and/or ready for issue tags that attest to the inspection and test status, and document that all product and quality characteristics conform to specifications and requirements. Verification stamps signify that those characteristics verified have been judged to be in conformance with appropriate specifications and requirements. Certification and verification stamp designs are unique to the particular purpose, and are traceable to the individual responsible for its use and for release of conforming products. When a task or operation is altered, reworked, entered, disturbed, or damaged after certification and/or verification, retesting, recertification, and when applicable, reverification will occur.

Nonconforming products are identified, documented, and segregated, where applicable using a discrepancy work order or a material review report (see 4.13.2).

4.12.1 Related documentation. Detailed approved methods are provided in the latest revisions of:

OPNAVINST 4790.2

4.13 CONTROL OF NONCONFORMING PRODUCT

4.13.1 General. Nonconforming material will be prevented from unauthorized use, shipment and intermingling with conforming material. Nonconforming material will be conspicuously marked, tagged, and segregated from conforming material, documented and stored to prevent inadvertent use, evaluated to determine disposition, and if applicable, disposed of.

4.13.2 Review and disposition of nonconforming product. Responsibility for disposition of nonconforming material will be defined and, when required, the customer will be contacted for concession (see 4.13.2b). Nonconforming material will be reviewed for repair, rework, use as is, hold for future repair, or scrap. Repaired or reworked material will be reinspected. Disposition of material will be recorded to reflect the actual condition (see 4.16).

4.13.3 Related documentation. Detailed approved methods are provided in the latest revisions of:

OPNAVINST 4790.2

4.14 CORRECTIVE AND PREVENTIVE ACTION

4.14.1 General. Documented procedures will be established and maintained for implementing corrective and preventive action. Corrective actions are done on errors, problems, and deficiencies that have already occurred. Preventive actions are those that are done to prevent potential errors, problems or deficiencies. Corrective and preventive action will be initiated to resolve identified root causes of deficiencies and to preclude recurrence. Corrective action will resolve the problems or deficiencies. Preventive action will prevent the occurrence of cited deficiencies by identification and elimination of root causes. Corrective and preventive action will be required when a deficiency is detected in a product, process, or system. Deficiencies will be classified according to their degree of severity. When applicable, changes to the documented procedures will be made as a result of implementing corrective and preventive action.

4.14.2 Corrective action. Causes of product, process and quality system nonconformities will be investigated and recorded (see 4.16). Product, process and quality system discrepancies identified during internal operations and customer identified problems will be analyzed to determine corrective and preventive action needed to eliminate the cause. Controls will be applied to ensure action is taken and effective.

4.14.3 Preventive action. Nonconformances will be identified through the performance of audits, complaints from our customers and any other appropriate quality records. Nonconformance data will be analyzed to eliminate potential causes, and to determine necessary steps to deal with problems requiring preventive action. Preventive action will be implemented with follow-up performed to ensure preventive action taken is effective. Actions taken will be presented to management for review (see 4.1.3).

4.14.4 Related documentation. Detailed approved methods are provided in the latest revisions of:

OPNAVINST 4790.2

4.15 HANDLING, STORAGE, PACKAGING, PRESERVATION AND DELIVERY

4.15.1 General. Documented procedures will be established and maintained for handling, storage, packaging, preservation and delivery of products. The purpose is to prevent damage, loss, deterioration, degradation, or unauthorized access or substitution of material.

4.15.2 Handling. Procedures and work instructions specify the means used for handling to prevent damage or deterioration. Special containers, transportation vehicles and appropriate protective measures will be applied with respect to handling.

4.15.3 Storage. Designated storage areas or stock rooms will be used to prevent damage or deterioration of products pending use or delivery. Procedures will be documented to establish methods for receipt and issuance of products from the storage areas and stock rooms. Products will be monitored to detect deterioration. Expired shelf life material will be tested for continued suitability or will be purged from the system.

4.15.4 through 4.15.6 Packaging, preservation, and delivery. Procedures, work instructions, agreements, and contracts specify the means used for packaging and preservation of finished products. Products being shipped must be properly labeled to indicate condition, packaging and preservation requirement to ensure safe arrival and identification at destination. Interstate Commerce Commission rules and applicable shipping regulations for our products shipped by commercial carriers is under the auspices of the Navy Supply Department.

4.15.7 Related documentation. Detailed approved methods are provided in the latest revisions of:

OPNAVINST 4790.2

4.16 CONTROL OF QUALITY RECORDS. Quality records reflecting objective evidence of quality, conformance to requirements, and the effective operation of the quality system will be maintained. Records for monitoring work performance and for inspection and testing will indicate the acceptability of work or products and the action taken in connection with deficiencies. Applicable quality records from subcontractors or vendors will be retained. Records will be complete, reliable, and easily retrievable, and may be viewed by our customers upon request.

Procedures and work instructions will specify the requirements for record retention, retention intervals and custodial responsibilities. The department that is responsible for their establishment, unless otherwise specified normally stores records. Quality records can be in the form of hard copy or electronic media. Records will be retained for a period of two years after completion unless otherwise stated in a procedure or work instruction.

4.16.1 Related documentation. Detailed approved methods are provided in the latest revisions of:

OPNAVINST 4790.2

4.17 INTERNAL QUALITY AUDITS. Documented procedures will be established and maintained for planning and implementing internal quality audits. Quality audits will provide an objective assessment of those factors influencing performance, operation and effectiveness of the quality system. Audits will compare actual performance, measured against a given set of standards, specifications or procedures.

Internal quality audits will be planned, scheduled, and documented (see 4.16). Internal audits will be scheduled based on status and importance of the activity to be audited, and will be performed by personnel independent of those having direct responsibility for the activity being audited. Appropriate levels of management within the responsible area will be informed of the results of the audits. Corrective action will be required by responsible personnel on deficiencies identified during the audit. Follow-up audits will be conducted to verify and record the effectiveness of corrective action taken.

The individual focus group Quality Manuals will establish responsibility for determining audit priorities, reviewing audit reports, and assigning responsibilities for corrective action within their focus groups.

4.17.1 Related documentation. Detailed approved methods are provided in the latest revisions of:

OPNAVINST 4790.2

4.18 TRAINING. Individual Training Records (ITR) are developed for each employee based on position duties and responsibilities. Supervisors will periodically evaluate the effectiveness of training, ensure the ITR is current and all training is appropriately documented. Personnel performing certification and verification of products produced will be qualified on the basis of training and/or experience, as required. Records of training and qualification/ requalification will be maintained as required in applicable procedures (see 4.16).

Work Center Supervisors have the responsibility to create job descriptions that define the duties and knowledge required to perform the job. The Human Resource Office will provide oversight in accordance with established government standards. Training programs will be established to maintain the skills of personnel.

4.18.1 Related documentation. Detailed approved methods are provided in the latest revisions of:

OPNAVINST 4790.2

4.19 SERVICING. Where appropriate, the AIMD will establish and maintain procedures for performing, verifying and reporting that servicing meets the requirements. Servicing shall include those functions performed by field teams, investigation and repair of material reported and calibration services.

4.19.1 Related documentation.

OPNAVINST 4790.2

4.20 STATISTICAL TECHNIQUES

4.20.1 Identification of need. Statistical planning and analysis will be used whenever suitable to maintain the required control of quality. Continuous process improvement opportunities will be identified through the use of effective analysis of data. Statistical methods will provide valid confidence and quality levels. Statistically valid sampling plans will be used to provide valid confidence levels on products and processes. Records will reflect the results of statistical analysis.

4.20.2 Procedures. Documented procedures will be established and maintained to implement and control the application of statistical techniques (see 4.20.1).

4.20.3 Related documentation. Detailed approved methods are provided in the latest revisions of:

OPNAVINST 4790.2

APPENDIX D. TOOL CONTROL PROGRAM FORMS. FROM REF. [2].

Missing/Broken/Worn Tool Report

Report No:_____

A. Originator _____ _____
Print Name Rate/Rank Date/Time

BUNO/EQUIP_____ _____
Part No. Serial No.

Container_____
No. Panel/Drawer/Item

Division/Work Center_____ NSN/Tool Description _____
_____

Circumstances/Explanation:_____
_____
_____
(Continue on reverse, if required)

_____ _____
Originator Signature Work Center Supervisor Signature

NOTE: Complete sections A, B, and F for Broken/Worn Tool Reports. A missing tool requires a completed investigation and report.

B. QA Investigator Report and Recommendation:_____
_____
_____

_____ _____
Signature/Rate/Rank Date/Time

C. QA Officer Recommendation:_____
_____

_____ _____
Signature/Rate/Rank Date/Time

D. Maintenance/Production Control
Investigator Assigned by QA Officer _____
Remarks:_____

_____ _____
Signature/Rate/Rank Date/Time

E. MO

Aircraft Release for Flight/Equipment Release for Use Yes / No
Comments ____ _____

_____ _____

Signature/Rate/Rank Date/Time

F. TCP Coordinator
Broken/Worn Tool Received By: _____ Date: _____

Tool replaced from spare Yes / No SERVMART Item Yes / No

Document No. _____ SERVMART Date: _____

Supply Status _____
Tool Issued

_____ _____

TCP Coordinator Signature Rate/Rank Date Tool Control Representative Signature Rate/Rank Date

Tool Container Change Request

Date_____ Work Center_____

NSN/PN_____ CAGE _____

Nomenclature _____ QTY _____

Tool Container No. _____ Drawer _____

Item Number_____ ADD DELETE MODIFY (circle one)

Justification_____

_____

_____

_____

_____

_____

_____
Originator

Appropriate Signatures

Work Center Supervisor_____ Date _____
Recommended/Not Recommended

Division Officer _____ Date_____
Recommended/Not Recommended

QA _____ Date_____
Recommended/Not Recommended

MMCO_____ Date_____
Approved/Disapproved

TCP Coordinator (Action taken)

Tool Issued From: Spare_____ SERVMART _____

On Order/Requisition No. _____

Tool Issued To: _____ Date _____
(Work Center Supervisor/Tool Control Representative)*

Deleted Tool Received From:*_____ Date _____

TCP Coordinator:* _____ Date _____

* Ensure signature is legible

From: _____
To: _____

Subj: TOOL CONTROL MANUAL (TCM) CHANGE/DEVIATION REQUEST

Ref: (a) OPNAVINST 4790.2G

1. Per reference (a), request to change/deviate from TCM NAVAIR: _____

   a. TCM Container No.: _____

   b. Deviation Requested: _____
   _____
   _____
   _____

   c. Justification: _____
   _____
   _____
   _____

2. Point of Contact: _____

DSN: _____ Commercial: _____

FIRST ENDORSEMENT

From: _____
To: _____

Subj: TOOL CONTROL MANUAL (TCM) CHANGE/DEVIATION REQUEST

Ref: (a) OPNAVINST 4790.2G

1. Per reference (a), request to change/deviate from TCM NAVAIR _____ is approved/ disapproved.

2. The following circumstances apply: _____
   _____
   _____

Signature: _____ Date: _____

Copy to:
(As appropriate)

CONTAINER SHORTAGES

Tool Container No: _____

NOMENCLATURE DRAWER/PANEL/ITEM	TOOL REPORT NO	DOCUMENT NO	TOOL CONTROL REPRESENTATIVE INITIALS	DATE REPLACED	WC SUPERVISOR INITIALS

TOOLS INDUCTED FOR CALIBRATION

NOMENCLATURE DRAWER/PANEL/ITEM	DATE INDUCTED FOR CALIBRATION	TOOL CONTROL REPRESENTATIVE INITIALS	DATE REPLACED	WC SUPERVISOR INITIALS

From: _____

To: Contractor/Field Maintenance Team

Subj: CONTRACTOR/FIELD MAINTENANCE TOOL CONTROL PROGRAM (TCP) AND FOREIGN OBJECT DAMAGE (FOD) BRIEF

Ref: (a) OPNAVINST 4790.2G

1. Reference (a) requires Quality Assurance (QA) brief contractor/field maintenance teams on the command TCP and FOD requirements prior to maintenance actions.

2. A Quality Assurance Representative (QAR) and the contractor/field maintenance team leader shall jointly conduct a tool inventory prior to and upon completion of each maintenance assignment. The team leader shall notify QA of any additional tools introduced after the initial tool inventory. If the volume of tools preclude a practical inventory, the team leader will list each tool used to certify accountability following work accomplishment.

3. The team leader shall immediately notify QA upon discovery of a missing or broken tool. Tools broken during a maintenance action will be sighted by a QAR, and all pieces accounted for.

4. I have been briefed by the activity QAR on the responsibilities of all personnel working in, on and around aircraft/systems/components/Support Equipment with respect to proper TCP and FOD procedures. Copy of tool inventory attached.

Team Leader Signature _____ Date: _____

5. Aircraft/system/component under repair; remarks: _____

_____

_____

6. (a) Prior to maintenance, tool containers inventoried by:

Team Leader Signature _____ Date: _____

QAR Signature _____ Date: _____

(b) Upon completion of maintenance, tool containers inventoried by:

Team Leader Signature _____ Date: _____

QAR Signature _____ Date: _____

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   Naval Postgraduate School
   Monterey, CA 93943

5. Dr. Bruce E. Laviolette 1
   Business Operations Division Director
   Naval Engine Airfoil Center
   Naval Aviation Depot
   PSC Box 8021
   Cherry Point, NC 28533-0021

6. CDR Tom R. Hamman 2
   Assistant Commander for Logistics
   Project Integration
   Logistics Support Detachment
   Naval Air Systems Command (AIR-3.6B)
   Bldg. 447, Room 210
   47056 McLeod Road, Unit 8
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   47123 Buse RD., Unit IPT
   Patuxent River, MD 20670-1547

8. Chief of Naval Operations 1
ATTN: N881C3C CDR Jeri Sue King
Presidential Towers, NC-1, Suite 7200
2511 S. Jefferson Davis Highway
Arlington, VA 22203-2000

9. LT(jg) Stephen K. Brenneman 1
5 Aguila
Aliso Viejo, CA 92656